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US005951300A

United States Patent [19]

Brown

[11] Patent Number: 5,951,300

[45] Date of Patent: Sep. 14, 1999

[54] **ONLINE SYSTEM AND METHOD FOR PROVIDING COMPOSITE ENTERTAINMENT AND HEALTH INFORMATION**

[75] Inventor: **Stephen J. Brown**, Mountain View, Calif.

[73] Assignee: **Health Hero Network**, Mountain View, Calif.

[21] Appl. No.: **08/814,293**

[22] Filed: **Mar. 10, 1997**

[51] **Int. Cl.**[6] **G09B 19/00**; G09B 23/28

[52] **U.S. Cl.** **434/236**; 434/262

[58] **Field of Search** 434/118, 236, 434/237, 238, 262; 345/326, 327, 328, 329, 333, 334, 335, 339, 342, 347

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,304,112 4/1994 Mrklas et al. 600/27

5,307,263 4/1994 Brown 600/301

Primary Examiner—Robert A. Hafer

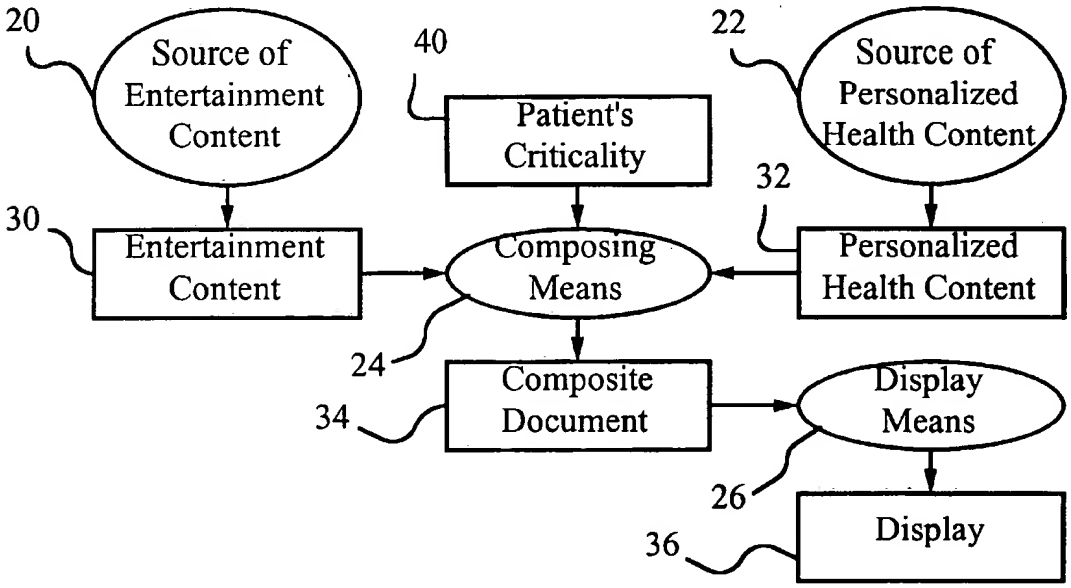
Assistant Examiner—John Edmund Rovnak

Attorney, Agent, or Firm—Lumen Intellectual Property Services

[57] **ABSTRACT**

On-line health education includes displaying composites of personalized health content and patient-selected entertainment. Suitable sources of entertainment include generally available web pages and television programs. Composites are spatial (for page displays) or temporal (for image sequence displays). Health content is customized to health and personal situations of individual patients, and replaces advertisements. Composites are generated on a central server in communication with an entertainment server and a health server. Amenable diseases or behaviors include diabetes, asthma, hypertension, cardiovascular disease, eating disorders, HIV, mental health disorders, smoking, and alcohol and drug abuse.

48 Claims, 6 Drawing Sheets



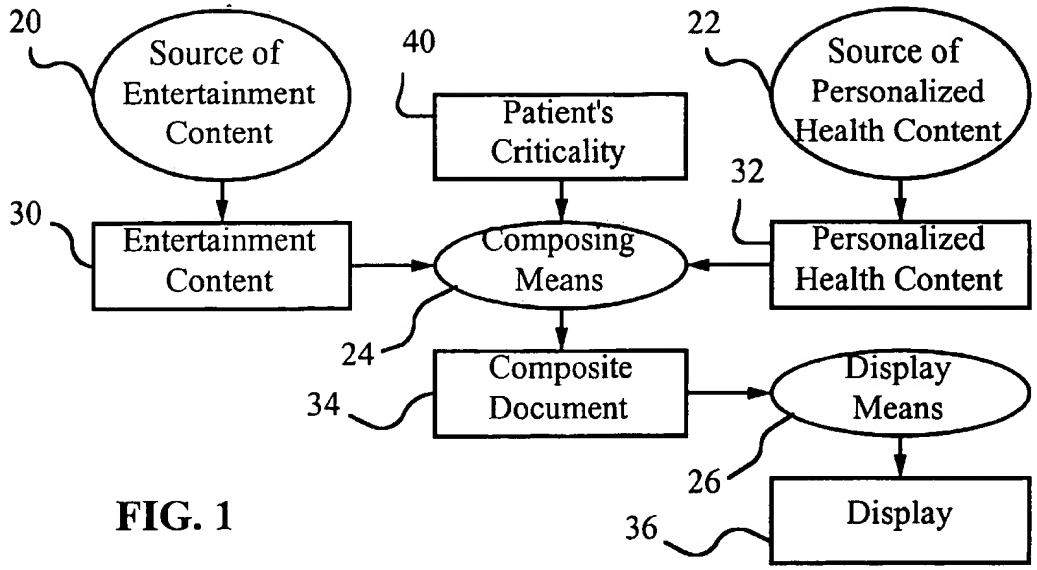

20
Source of Entertainment Content
40
Patient's Criticality
22
Source of Personalized Health Content
30
Entertainment Content
Composing Means
32
Personalized Health Content
24
Composite Document
34
Display Means
26
Display
36

FIG. 1

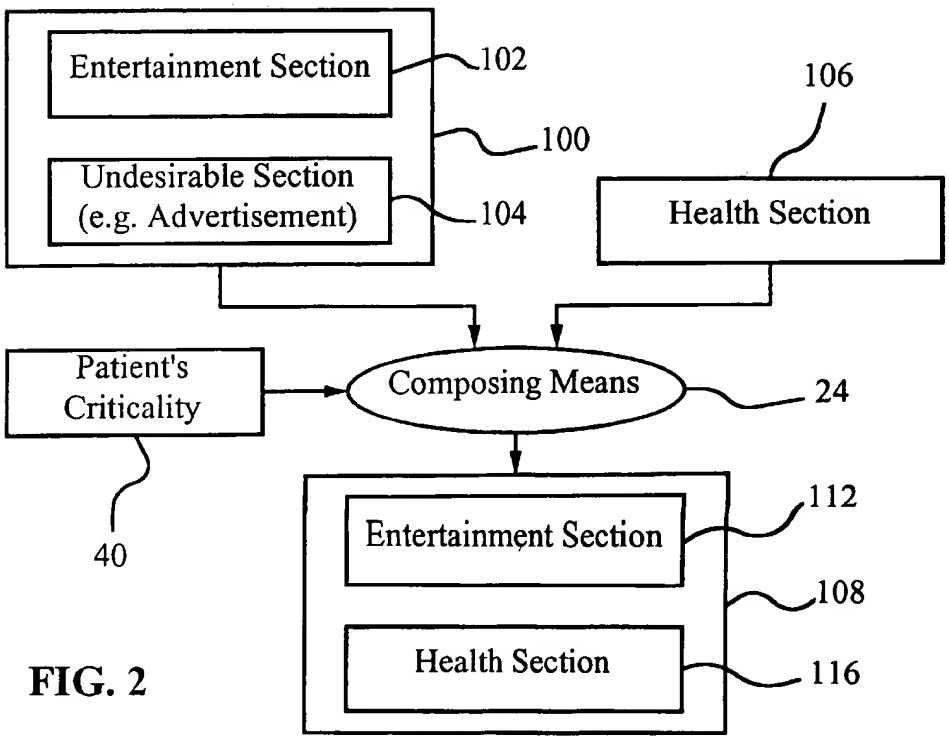
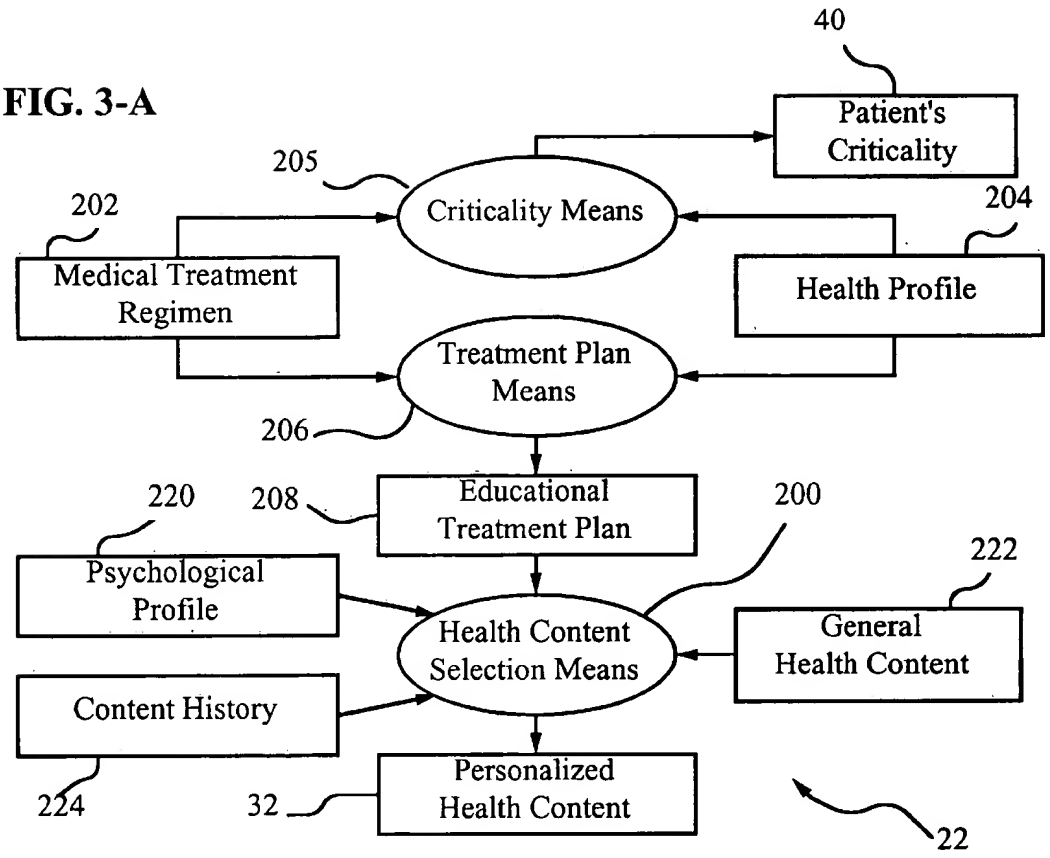

Entertainment Section
102
100
Undesirable Section (e.g. Advertisement)
104
106
Health Section
Patient's Criticality
Composing Means
24
40
112
Entertainment Section
108
Health Section
116

FIG. 2

FIG. 3-A


40
Patient's Criticality
205
Criticality Means
202
204
Medical Treatment Regimen
Health Profile
Treatment Plan Means
206
220
208
Educational Treatment Plan
200
222
Psychological Profile
Health Content Selection Means
General Health Content
Content History
224
32
Personalized Health Content
22

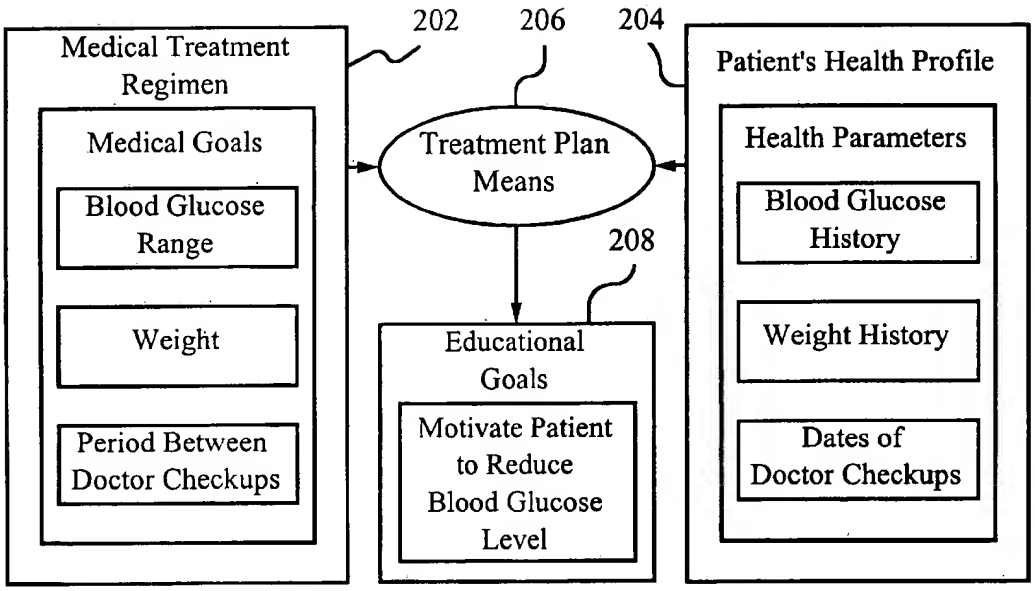

202
206
204
Medical Treatment Regimen
Medical Goals
Blood Glucose Range
Weight
Period Between Doctor Checkups
Treatment Plan Means
208
Educational Goals
Motivate Patient to Reduce Blood Glucose Level
Patient's Health Profile
Health Parameters
Blood Glucose History
Weight History
Dates of Doctor Checkups

FIG. 3-B

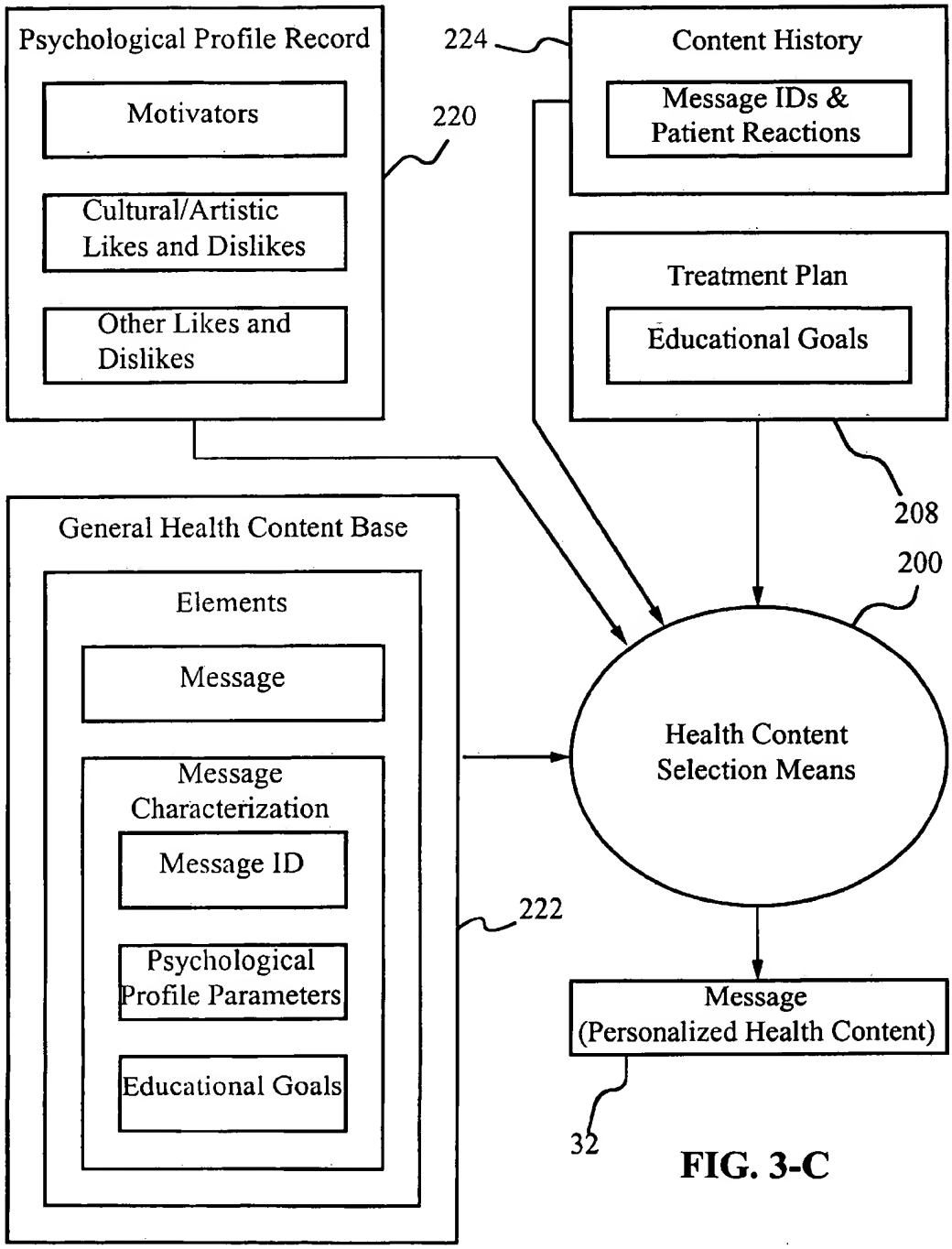

Psychological Profile Record
Motivators
Cultural/Artistic Likes and Dislikes
Other Likes and Dislikes
220
224
Content History
Message IDs & Patient Reactions
Treatment Plan
Educational Goals
208
200
General Health Content Base
Elements
Message
Message Characterization
Message ID
Psychological Profile Parameters
Educational Goals
222
Health Content Selection Means
Message (Personalized Health Content)
32

FIG. 3-C

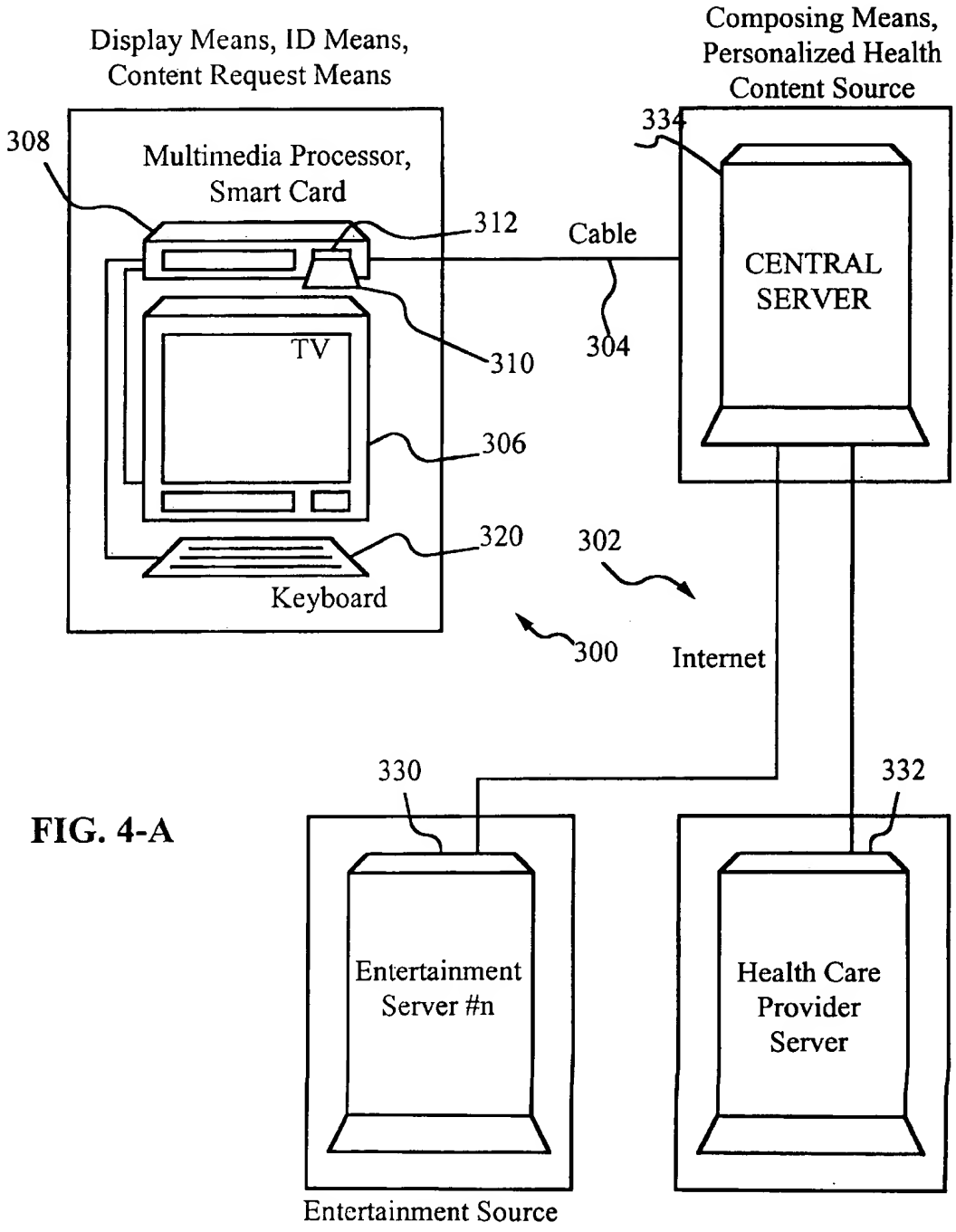

Display Means, ID Means,
Content Request Means
Composing Means,
Personalized Health
Content Source
308
Multimedia Processor,
Smart Card
334
312
Cable
CENTRAL
SERVER
TV
310
304
306
320
302
Keyboard
300
Internet
330
332
Entertainment
Server #n
Health Care
Provider
Server
Entertainment Source

FIG. 4-A

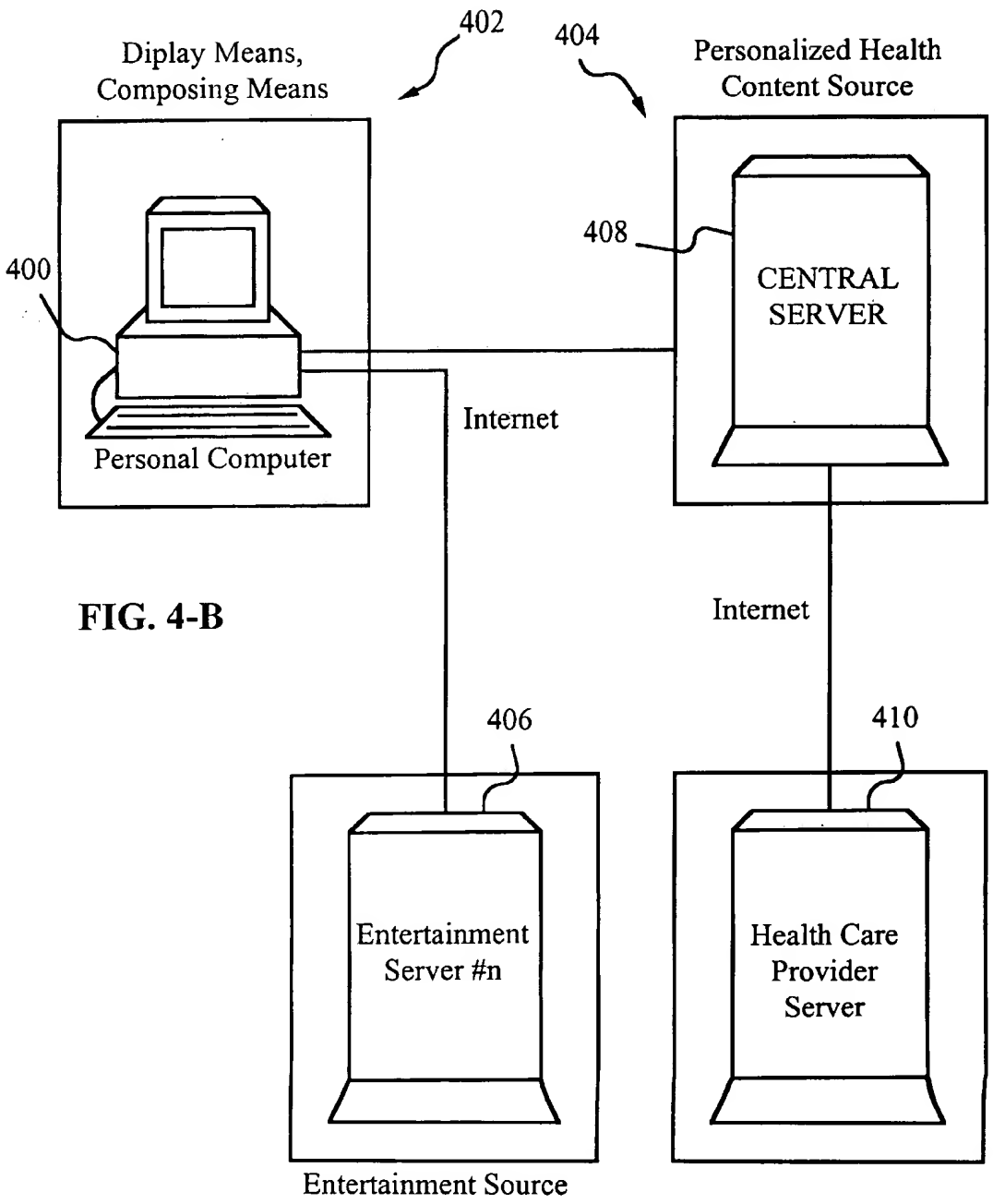

402
404
Diplay Means,
Composing Means
Personalized Health
Content Source
400
408
CENTRAL
SERVER
Personal Computer
Internet
Internet
406
410
Entertainment
Server #n
Health Care
Provider
Server
Entertainment Source

FIG. 4-B

ONLINE SYSTEM AND METHOD FOR PROVIDING COMPOSITE ENTERTAINMENT AND HEALTH INFORMATION

RELATED APPLICATION DATA

This invention relates to co-pending U.S. patent application Ser. No. 08/669,613 filed Jun. 24, 1996, "On-Line Health Education and Feedback System using Motivational Driver Profile Coding and Automated Content Fulfillment," by inventor Stephen J. Brown, and to co-pending U.S. Patent Application "System and Method for Modifying Documents Sent Over a Communications Network," by inventors Stephen J. Brown and Konstantin Othmer. The above-mentioned U.S. Patent Applications are herein incorporated by reference.

FIELD OF THE INVENTION

This invention relates to the field of health education, and in particular to an on-line system and method for displaying to a patient a composite of patient-selected entertainment content and personalized educational health content.

BACKGROUND OF THE INVENTION

The health care community has recognized in recent years the importance of preventive care in managing patients' health. Preventive care is important for managing the health of patients having chronic diseases or long-term conditions, as well as for reducing the incidence of undesirable behavior (e.g. smoking) in at-risk patients. Preventive care includes educating patients about diseases and/or health consequences of behavior, ensuring communication between patients and health care providers (e.g. doctors), and providing patients with tools and/or treatments for managing diseases or behaviors.

Commonly used preventive care approaches suffer from several drawbacks. Much of preventive care is voluntary, and thus a large fraction of preventive care resources is typically spent on patients who actively seek involvement in their care. A large number of patients do not actively seek information and treatment in the absence of symptoms. Also, health care providers receive very little information on whether patients are complying with preventive care guidelines. Thus, health care providers often are not able to take remedial steps before the disease affects patients symptomatically (e.g. through pain). Reaching passive patients and people at risk for developing medical conditions is critical to delivering effective preventive care.

The mass-marketing techniques used for health education by most health maintenance organizations (HMOs) and insurance companies allow little customization of information to an individual patient's needs. Consequently, many patients may not directly identify with the educational approaches used by their health care providers. Personalizing health education would significantly raise the effectiveness of preventive health care, especially in children and adolescents.

In U.S. Pat. No. 5,542,420, Goldman et al. describe a system for prescribing personalized diets to individual patients. Health profiles of the patients are used to generate the personalized diets. The system described by Goldman et al. requires patient initiative in the prescription process.

In U.S. Pat. No. 5,140,419, Galumbeck et al. describe a multiply-hierarchical data delivery system capable of addressing receivers singly or in groups. The Galumbeck et al. patent does not discuss health education issues. Other U.S. Patent Nos. related to selective addressing of receivers include U.S. Pat. Nos. 5,565,909 and 5,432,542 by Thibadeau et al., and U.S. Pat. No. 4,264,924 and U.S. Pat. No. 4,264,925 by Freeman et al.

None of the above-mentioned disclosures provides a system or method capable of delivering personalized health information to a patient, without requiring an express request for the information by the patient.

OBJECTS AND ADVANTAGES OF THE INVENTION

Accordingly, it is a primary object of the present invention to provide a system and method for delivering personalized health content to a patient, without requiring specific patient requests for the health content. The system allows delivering personalized health content in the course of normal recreational activities of the patient. Personalizing the health content improves the educational effectiveness of the method. The system allows the use, without substantial modification, of pre-existing spatial or temporal layouts of entertainment programming. The use of a dedicated server for data processing and storage allows a reduction in the amount of data transferred over relatively low-bandwidth communication lines to patients' homes.

SUMMARY OF THE INVENTION

A system for delivering personalized health information comprises a source of personalized health content, a source of entertainment content, a composing means in communication with the sources of entertainment and personalized health content, and a display means in communication with the composing means.

The composing means generates a composite of entertainment content and personalized health content. The display means generates a display of the composite.

The source of entertainment content is in communication with a content request means for allowing the patient to expressly request specific entertainment content, i.e. to "pull" content from the source of entertainment content. The entertainment content is delivered to the composing means following an express patient request for the entertainment content.

The source of personalized health content comprises a health content selection means in communication with a set of inputs. The health content selection means generates the personalized health content according to data from the set of inputs. The set of inputs comprises a general health content base and inputs allowing the selection of content from the general health content base. Inputs used for content selection include a medical treatment regimen, a health profile, an educational treatment plan, a psychological profile, and a content history of the patient. A treatment plan means generates the educational treatment plan from the treatment regimen and health profile of the patient.

The medical treatment regimen specifies target health parameters, while the health profile specifies actual health parameters of the patient. The treatment plan is generated by comparing the target parameters to the actual parameters. The treatment plan specifies educational goal parameters of the patient. The educational goal parameters measure the importance of corresponding educational goals for the particular patient. The psychological profile comprises data characterizing likes, dislikes, and motivators of the patient. The content history identifies the health content to which the patient has been exposed within a given time period.

The composing means generates the composite according to a patient criticality. The patient criticality measures the patient's compliance with the treatment regimen. A criticality means generates the patient criticality by comparing the treatment regimen and the health profile.

The composite is preferably a spatial composite. That is, the composite comprises a composite page including both entertainment and health content. The composite page comprises an entertainment section comprising the entertainment content and a health section comprising the health content. The source of entertainment content generates an original page comprising an entertainment section and an undesirable section (e.g. an advertisement). The composing means replaces the undesirable section with a health section, thereby generating the composite page. The page layout of the composite page is substantially identical to the page layout of the original page. A spatial composite preferably comprises a hypertext markup language (HTML) document.

In an alternative embodiment suited for television health education, the composite is a temporal composite. The display of the composite then comprises an image sequence comprising a first image and a second image, wherein the first image comprises the entertainment content and the second image comprises the health content. The first image consists substantially of the entertainment content, while the second image consists substantially of the health content.

The system comprises a client subsystem comprising the display means, and a server subsystem in communication with the client subsystem over a remote network. The display means preferably comprises a television set and a multimedia processor. Suitable remote networks include the Internet and communications lines used for cable television delivery. The server subsystem preferably comprises the composing means and the entertainment and health content sources. The server subsystem, and in particular the source of health content, is in communication with a plurality of client subsystems, where each client subsystem corresponds to a different patient, and where data is customized (personalized) independently for each client subsystem.

The present invention further provides a method of delivering health information to a patient. The method comprises the steps of generating the composite of personalized health content and patient-requested entertainment content, and displaying the composite to the patient.

DESCRIPTION OF THE FIGURES

FIG. 1 is a high-level block diagram illustrating the operation of a system of the present invention.

FIG. 2 illustrates the generation of a composite page by substitution of a health section for an undesirable section in an original page, according to the present invention.

FIG. 3-A is a block diagram illustrating a preferred method of generating a patient criticality and personalized health content, according to the present invention.

FIG. 3-B is a block diagram exemplifying structures for a medical treatment regimen, health profile, and educational treatment plan for a diabetes patient, according to the present invention.

FIG. 3-C is a block-diagram exemplifying preferred structures for a general health content base, psychological profile, and content history, according to the present invention.

FIG. 4-A shows preferred hardware and connections for a system of the present invention.

FIG. 4-B shows an alternative arrangement of hardware according to a system of the present invention.

DETAILED DESCRIPTION

In the following description, a source of content is understood to include a record of the content (e.g. a HTML file), or hardware used to store the content (e.g. a server). Personalized health content is understood to refer to health content that is personalized to an individual patient's health situation, and not merely to a health situation of a generic patient having a given disease. In a system for delivering health information to a plurality of patients, personalized health content is understood to refer to health content customized individually for each patient. The statement that an input is in communication with some data processing means is understood to mean that the data processing means is adapted to use (directly or indirectly) data specified by the input. The term server is understood to refer to an information-generating device capable of communicating with a plurality of clients; servers include computer servers and television delivery systems. The term patient is understood to refer to persons suffering from a condition or disease, as well as persons at risk for engaging in behavior having adverse health consequences.

The following discussion will focus on a computer-based implementation of a system and method for diabetes preventive health care. It will be clear to the skilled artisan that the present invention is suitable for preventive care directed to many other health conditions. Moreover, there are many well known structures, interfaces and processes that are suitable for implementing the present invention.

FIG. 1. illustrates generally a health information delivery system of the present invention. A source of entertainment content **20** and a source of personalized health content **22** are in communication with a composing means **24**, which in turn is in communication with a display means **26**. Source **20** generates entertainment content **30**, while source **22** generates personalized health content **32**. Composing means **24** generates a composite document **34** comprising entertainment content **30** and personalized health content **32**. Display means **26** generates a display **36** of composite document **34**. A patient criticality or criticality data **40** is used by composing means **24** to modulate the relative display importance of health content **32** within display **36**.

Preferably, entertainment content **30** comprises a hypertext markup language (HTML) document requested by the patient under treatment. Personalized health content **32** comprises an HTML document encoding a personalized educational health message, while composing means **24** comprises computer software. Composite document **34** is preferably a HTML file. Display means **26** comprises computer software (e.g. a browser) capable of generating displays of HTML documents. It will be apparent to the skilled artisan that, in general, many formats other than HTML are available for entertainment content **30**, personalized health content **32**, and composite document **34**.

The composite is preferably a spatial composite. That is, entertainment and health content are displayed within the same composite page or image. FIG. 2 illustrates the generation of a spatial composite according to a preferred embodiment of the present invention. A conventional HTML entertainment document comprises an original page **100**. Original page **100** comprises an entertainment section **102** and an undesirable section **104**. Page **100** is a conventional web page such as a home page of a company or information provider. Undesirable section **104** comprises an advertisement not requested by the patient, or other information targeted for replacement.

Composing means **24** uses page **100** and a health section **106** to generate a composite page **108**. Composite page **108**

comprises an entertainment section **112** and a health section **116**. Preferably, entertainment section **112** is identical to entertainment section **102**. Composing means **24** thus essentially replaces undesirable section **104** with health section **116**. Health section **116** is preferably formatted to have substantially the same size as undesirable section **104**, such that the page layout of composite page **108** is similar to the page layout of original page **100**. Health section **116** comprises a link to further information related to the subject of health section **116**; the patient accesses the link by clicking on health section **116**. In an alternative embodiment (not illustrated), a composite page is generated by adding a health section to an original page, without removing any undesirable section from the original page.

Generating page sections of predetermined size using HTML is well known in the art. Generating HTML composites and recognizing advertising sections of HTML documents are described in detail in the above-incorporated U.S. Patent Application "System and Method for Modifying Documents Sent Over a Communications Network."

Criticality data **40** modulates the mixing of entertainment section **102** and health section **106**. Criticality data **40** measures the patient's compliance with a doctor-prescribed treatment regimen. Criticality data **40** modulates the relative display importance of section **116** within page **108**. The relative display importance preferably includes the probability that undesirable section **104** is replaced by health section **116**. For a patient managing his or her health successfully, composite page **108** may include a limited number of health sections **116** and a relatively large number of advertising sections. For a patient not in compliance with the treatment regimen, composite page **108** includes a large number of health sections **116**. In another embodiment, relative display importance includes the size and placement of health section **116** within page **108**; the page layout of composite page **108** is then generally different from the page layout of original page **100**.

FIG. **3**-A illustrates the steps used to generate personalized health content **32** in a preferred embodiment of the present invention. Source **22** of personalized health content **32** comprises a health content selection means **200** in communication with a set of inputs. The set of inputs provides data for generating personalized health content **32**.

The set of inputs of selection means **200** comprises a base of general health content **222**. General health content **222** is generated and updated using research on communicating health information. The general health content base **222** is preferably a large database of messages comprising video, audio, hypertext, and/or text-to-speech data. Each element of general health content base **222** comprises a message and a message characterization, as illustrated in FIG. **3**-C. The message characterization comprises an explicit or implicit description of the message. In particular, the message characterization comprises information on the treatment plans and psychological and/or health profiles for which the message is suitable or effective. In a preferred embodiment, the message characterization comprises tags indicating the effectiveness of the corresponding message for given treatment plan, psychological profile, and health profile parameters.

The set of inputs of selection means **200** comprises a patient psychological profile **220**, as shown in FIG. **3**-A. Psychological profile or psychological profile record **220** contains information about the patient's psychology, including his or her likes, dislikes, and motivators. For example, psychological profile **220** includes parameters characterizing the patient's response to various motivating factors such as love of family or fear of adverse health consequences, and the patient's interest for cultural or artistic subjects such as football or jazz music. The data of psychological profile **220** is gathered from tests of the patient, from questionnaires, and by monitoring the patient's usage of the system. Psychological profile **220** records the subjects corresponding to the health sections on which the patient has requested information (by clicking on the sections).

Selection means **200** compares parameters of psychological profile **220** with corresponding parameters of message characterizations. Selection means **200** then tends to select for display messages which fit the patient's psychological profile. For example, for a diabetes patient motivated by fear of adverse future health consequences, selection means **200** is likely to select messages describing long term adverse health consequences (e.g. blindness, amputation) resulting from poor diabetes health care. For a patient motivated by money, selection means **200** tends to select messages that communicate the financial benefits of maintaining blood glucose levels within prescribed ranges. For a patient motivated by love of family, selection means **200** tends to select messages emphasizing the importance of proper care to the patient's family. In general a patient responds to a plurality of motivational factors.

The set of inputs further comprises a medical treatment regimen **202**. Treatment regimen **202** preferably comprises a set of doctor-prescribed medical goals or target health parameters for the patient.

For a diabetes patient, such parameters include target range of blood glucose levels, weight, exercise times, parameters characterizing the patient's diet, and recommended period between doctor checkups.

The set of inputs further comprises a health profile **204** of the patient. Health profile **204** comprises a set of actual health parameters of the patient. At least some of the actual health parameters defined by health profile **204** correspond to the target health parameters of treatment regimen **202**. For a diabetes patient, health profile **204** includes a history of the patient's blood glucose reading, as well as the patient's weight, age, date of last doctor checkup, and other information relevant to the patient's health. Suitable parameters for characterizing diseases other than diabetes can be readily determined by an artisan of average skill.

A criticality means **205** generates criticality **40** by comparing treatment regimen **202** and health profile **204**. Preferably, criticality **40** comprises a criticality index that measures differences between actual health parameters of the patient (as reflected in health profile **204**) and corresponding recommended health parameters of the patient (as determined from treatment regimen **202**). For example, for a diabetes patient the criticality index increases if the patient's current blood glucose reading is not within a prescribed range, or if the period since the patient's last doctor checkup is longer than the recommended period between doctor checkups. Exact dependencies of criticality indices on actual and recommended health parameters can be readily determined by the skilled artisan according to the disease under treatment and the medical data available for the patient.

A treatment plan means **206** generates an educational treatment plan **208** from treatment regimen **202** and health profile **204**. FIG. **3**-B illustrates schematically an example of the generation of an educational treatment plan for a diabetic patient. Educational treatment plan **208** is an educational prescription customized to the patient's current health situ-

ation. Educational treatment plan **208** includes a set of parameters characterizing the importance of various health goals for the treatment of the patient. For example, if the patient's blood glucose readings are higher than the range prescribed by the patient's doctor (specified by regimen **202**), an important educational goal of treatment plan **208** is to motivate the patient to reduce his or her blood glucose levels.

Educational treatment plan **208** is an input for health content selection means **200**. Health content selection means **200** compares parameters of educational treatment plan **208** with corresponding parameters of message characterizations. Selection means **200** then tends to select messages which fit the patient's educational treatment plan **208**. For example, if a goal of treatment plan **208** is to motivate the patient to reduce his or her blood glucose level, selection means **200** tends to select messages relating to blood glucose level.

The set of inputs of selection means **200** further comprises a content history **224** of the patient. Content history **224** keeps track of which messages the patient has seen, and whether the patient requested additional information in response to each message. Content history **224** allows the delivery of complementary and non-repetitive messages to the patient, over time. Some content is designed to be delivered over a series of messages. Content history **224** allows the delivery of pre-determined sequences of messages, and in particular of content designed to be delivered over time. Content history **224** is used to update psychological profile **220** according to the subjects of the messages in response to which the patient has requested additional information.

FIG. **3**-C illustrates an example of the selection by selection means **200** of a message from general health content base **222**. Selection means **200** preferably compares the message characterizations of each message to the data characterizing a patient profile, and selects for composing messages whose characterizations match the patient profile. The patient profile includes the patient's educational treatment plan **208**, content history **224**, and health and psychological profiles **204** and **220** respectively.

FIG. **4**-A illustrates the hardware and connections in a system for delivering personalized health information, according to a preferred embodiment of the present invention. The system comprises a client subsystem **300** located at the patient's home, and a server subsystem **302** capable of communication over a remote network with client subsystem **300**. The remote network preferably comprises a communications line **304** conventionally used for delivery of cable television programming. Preferably, server subsystem **302** is in communication with a plurality of different client subsystems **300**. The information delivered by server subsystem **302** is individually personalized for each client subsystem **300**.

Client subsystem **300** comprises display means **26** for a particular patient. Display means **26** preferably includes a television set **306** connected to a multimedia processor **308**. A patient identification means **310** is capable of communication with multimedia processor **308**. Patient identification means **310** comprises a data-bearing card, or "smart card". Multimedia processor **308** has a receiving slot **312** for receiving card **310**. Card **310** contains an encrypted patient code identifying the patient, as well as an address of server subsystem **302** for allowing client subsystem **300** to connect to server subsystem **302**. The address preferably comprises a URL address.

A patient feedback means or content request means is in communication with multimedia processor **308**. The patient feedback means preferably comprises a keyboard **320**. The patient feedback means allows the patient to request a specific entertainment page, by transmitting to server subsystem **302** the URL address of the entertainment page. The patient feedback means also allows the patient to update psychological profile **220** and health profile **204**.

Server subsystem **302** preferably comprises an entertainment server **330** for generating entertainment content, a health server **332** comprising inputs for generating health data on the patient, and a central server **334** for generating personalized health content and the composite of entertainment and personalized health content. Health server **332** is preferably a database located at the patient's health care provider. Health server **332** contains the patient's health profile, standards of care for the patient's disease, and the medical treatment regimen prescribed by the patient's doctor. Central server **334** is connected to entertainment server **330** and health server **332** over the Internet. Central server **334** is connected to multimedia processor **308** over communications line **304**.

The patient feedback means sends to central server **334** a request for an entertainment document (e.g. an HTML file) located on entertainment server **330**. The entertainment document is any document generally available to the patient. For a page-based implementation, suitable entertainment documents include home pages of companies or organizations, Internet directories, and pages containing sports news or stock quotes. Central server **334** retrieves the entertainment document from entertainment server **330** and generates a composite document by splicing a health message into the entertainment document as described above. Central server **334** then sends the composite document to display means **26** for display.

FIG. **4**-B illustrates the hardware and connections in an alternative embodiment of the present invention. The display means comprises a computer **400** and conventional browsing software (e.g. the Navigator® from Netscape Communications) installed on computer **400**. The composing means comprises an extension to the browsing application. A client subsystem **402** comprises computer **400**, while a server subsystem **404** comprises an entertainment server **406**, a central server **408** and a health server **410**. Client subsystem **402** comprises the display and composing means, while server subsystem **404** comprises the sources of entertainment and personalized health content.

In yet another embodiment of the present invention, the display means comprises a conventional television set connected to a cable television delivery system capable of delivering individualized programming to each of the system's subscribers. The source of entertainment content comprises a television program, while the source of personalized health content comprises a personalized educational health message. The composing means comprises conventional equipment suitable for splicing the health message within the television program. In such a television-based implementation, the composite is preferably a temporal composite. That is, the composite display comprises an image sequence, with the entertainment and health content displayed within distinct images.

It will be clear to one skilled in the art that the above embodiment may be altered in many ways without departing from the scope of the invention. Various relative arrangements of inputs and processing means are suitable for generating personalized health content. The patient critical-

ity can be used as an input for the health content selection means. Various diseases or behaviors are amenable to preventive care according to a method of the present invention, including asthma, hypertension, cardiovascular disease, eating disorders, HIV, mental health disorders, smoking, and drug or alcohol abuse. Personalizing the health content can be achieved in the process of generating (rather than selecting) the health content. The health content need not contain only predetermined educational messages; suitable health content includes data from the patient's health profile. Accordingly, the scope of the invention should be determined by the following claims and their legal equivalents.

What is claimed is:

1. A system for delivering health information to a patient, comprising:

a) a source of personalized health content for providing personalized health content;

b) a source of entertainment content for providing entertainment content;

c) a composing means in communication with said source of personalized health content and said source of entertainment content, said composing means for generating a composite of said personalized health content and said entertainment content, wherein said personalized health content is transmitted from said source of personalized health content to said composing means via a remote network; and

d) a display means in communication with said composing means, for generating a display of said composite.

2. The system of claim **1**, wherein said source of personalized health content comprises a health content selection means in communication with a set of inputs, said health content selection means for generating said personalized health content according to data from said set of inputs.

3. The system of claim **2**, wherein said set of inputs comprises a general health content base.

4. The system of claim **2**, wherein said set of inputs comprises a medical treatment regimen of the patient.

5. The system of claim **4**, wherein said medical treatment regimen specifies a target health parameter of the patient.

6. The system of claim **2**, wherein said set of inputs comprises a health profile of the patient.

7. The system of claim **6**, wherein said health profile specifies an actual health parameter of the patient.

8. The system of claim **2**, wherein said set of inputs comprises an educational treatment plan of the patient.

9. The system of claim **8**, wherein said educational treatment plan specifies an educational goal of the patient.

10. The system of claim **8**, further comprising a treatment plan means for generating said educational treatment plan from a treatment regimen and a health profile.

11. The system of claim **10**, wherein said educational treatment plan means is adapted to generate said treatment plan by comparing a target health parameter specified by said treatment regimen to a corresponding actual health parameter specified by said health profile.

12. The system of claim **2**, wherein said set of inputs comprises a psychological profile of the patient.

13. The system of claim **12**, wherein said psychological profile characterizes a like and a motivator of the patient.

14. The system of claim **2**, wherein said set of inputs comprises a content history of the patient.

15. The system of claim **1**, wherein said composing means is adapted to generate said composite according to a criticality of the patient.

16. The system of claim **15**, further comprising a criticality means for generating said criticality by comparing a treatment regimen and a health profile of the patient.

17. The system of claim **1**, further comprising a content request means in communication with said source of entertainment content, for allowing the patient to request a delivery of said entertainment content to said composing means.

18. The system of claim **1**, wherein said composite comprises a composite page comprising said personalized health content and said entertainment content.

19. The system of claim **18**, wherein said composite page comprises a health section comprising said personalized health content; and an entertainment section comprising said entertainment content.

20. The system of claim **19**, wherein said source of entertainment content is adapted to generate an original page comprising an entertainment section and an undesirable section; and said composing means is adapted to replace said undesirable section with said health section, thereby generating said composite.

21. The system of claim **20**, wherein said composing means is adapted to replace said undesirable section with said health section such that a page layout of said composite page is substantially identical to a page layout of said original page.

22. The system of claim **20**, wherein said undesirable section comprises an advertisement.

23. The system of claim **1**, wherein said source of entertainment content is adapted to generate an entertainment document comprising said entertainment content and an undesirable content; and said composing means is adapted to replace said undesirable content with said personalized health content, thereby generating said composite.

24. The system of claim **1**, wherein said composite comprises hypertext markup language text.

25. The system of claim **1**, wherein said display of said composite comprises an image sequence comprising a first image and a second image, said first image comprising said entertainment content, and said second image comprising said personalized health content.

26. The system of claim **25**, wherein said first image consists substantially of said entertainment content, and said second image consists substantially of said personalized health content.

27. The system of claim **1**, further comprising a client subsystem located at a patient location and comprising said display means; and a server subsystem in communication with said client subsystem over a remote network.

28. The system of claim **27**, wherein said server subsystem comprises said composing means.

29. The system of claim **27**, wherein said server subsystem comprises said source of personalized health content.

30. The system of claim **27**, wherein said server subsystem is in communication with a plurality of client subsystems, said plurality of client subsystems corresponding to a plurality of patients.

31. The system of claim **27**, wherein said display means comprises a television set in communication with a multimedia processor.

32. A system for delivering health information to a patient, comprising:

a) a composing means for generating a composite of a personalized health content and an entertainment content, wherein said personalized health content is transmitted to said composing means via a remote network; and

b) a display means in communication with said composing means, said display means for generating a display of said composite.

33. A system for delivering health information to a plurality of patients, comprising:

a) a server subsystem including a source of health content for providing health content, said health content personalized to each of the plurality of patients, a source of entertainment content for providing entertainment content, and a composing means in communication with said source of health content and said source of entertainment content, said composing means for generating a composite of said health content and said entertainment content; and

b) a plurality of client subsystems corresponding to the plurality of patients, said plurality of client subsystems in communication with said server subsystem, each of said plurality of client subsystems comprising a content request means, said content request means in communication with said source of entertainment content via a remote network, said content request means for allowing the patient to expressly request said entertainment content, and each of said plurality of client subsystems further comprising a display means, said display means in communication with said composing means, said display means for generating a display of said composite.

34. A method of delivering health information to a patient, comprising the steps of:

a) transmitting personalized health content and entertainment content over a remote network to a composing means;

b) generating, via the composing means, a composite of the personalized health content and the entertainment content; and

c) displaying the composite to the patient.

35. The system of claim 1, wherein said composite comprises a document.

36. The system of claim 35, wherein said document comprises a message including health content, said health content personalized to the patient.

37. The system of claim 1, wherein said source of entertainment content comprises an entertainment server, and said entertainment content is provided to said composing means via a remote network.

38. The system of claim 1, wherein said composite is generated by a central server, said central server in communication with said display means via a remote network.

39. The system of claim 1, wherein said remote network comprises the Internet.

40. The system of claim 32, wherein said entertainment content is transmitted to said composing means via a remote network.

41. The system of claim 32, further comprising a health care provider server, at least one entertainment server, and a content request means, wherein said content request means allows the patient to request said entertainment content from said at least one entertainment server, and said content request means further allows the patient to provide psychological profile data and health profile data to said health care provider server.

42. The system of claim 32, further comprising a central server, said central server in communication with said display means via a remote network.

43. The system of claim 32, wherein said composing means comprises a central server.

44. The system of claim 33, wherein said server subsystem comprises an entertainment server for generating entertainment content, a health server comprising inputs for generating health data on the patient, and a central server for generating personalized health content and for generating said composite of said health content and said entertainment content.

45. The system of claim 44, wherein said health server contains a health profile, standards of care for a disease of the patient, and a medical treatment regimen prescribed for the patient.

46. The method of claim 34, wherein the composite is displayed to the patient via a display means, the display means adapted to display a document or text data.

47. The method of claim 46, wherein the display means comprises a computer and browsing software, and wherein the composing means comprises an extension to the browsing software.

48. The method of claim 34, wherein the personalized health content and the entertainment content are transmitted to a central server, the central server comprising the composing means.

* * * * *

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United States Patent [19]

Frid et al.

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[45] Date of Patent: Jan. 12, 1999

[54] **UNIVERSALLY ACCESSIBLE HEALTHCARE DEVICES WITH ON THE FLY GENERATION OF HTML FILES**

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[52] **U.S. Cl.** **600/301**; 128/920; 128/904

[58] **Field of Search** 128/904, 920; 600/301; 395/187.01

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Primary Examiner—William E. Kamm
Assistant Examiner—Kennedy J. Schaetzle

[57] **ABSTRACT**

A universally accessible healthcare device having a communication path and a server. The healthcare device generates a set of medical information and the server provides access to the medical information using an open standard network protocol on the communication path. HTML Files may be generated on the fly by the server in response to an HTTP command from a requesting web client.

22 Claims, 2 Drawing Sheets

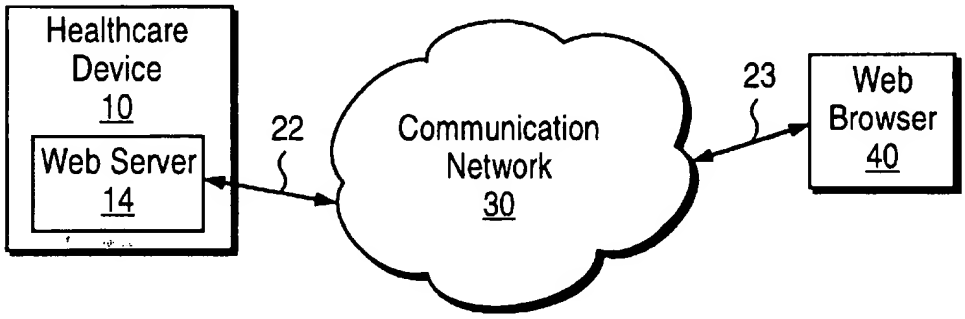


FIG. 1

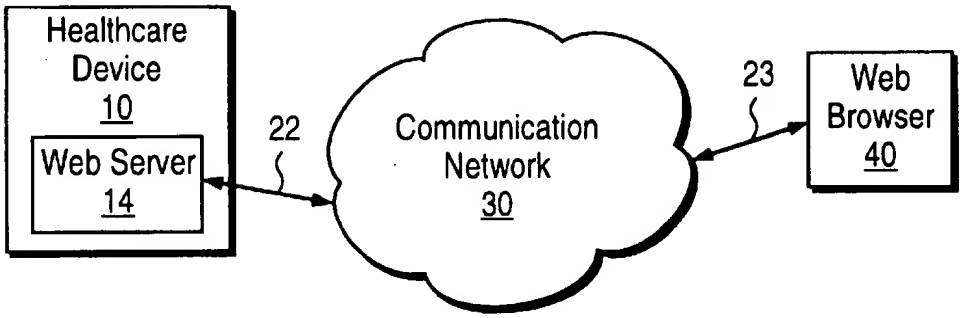

Healthcare Device 10
Web Server 14
22
Communication Network 30
23
Web Browser 40

FIG. 2

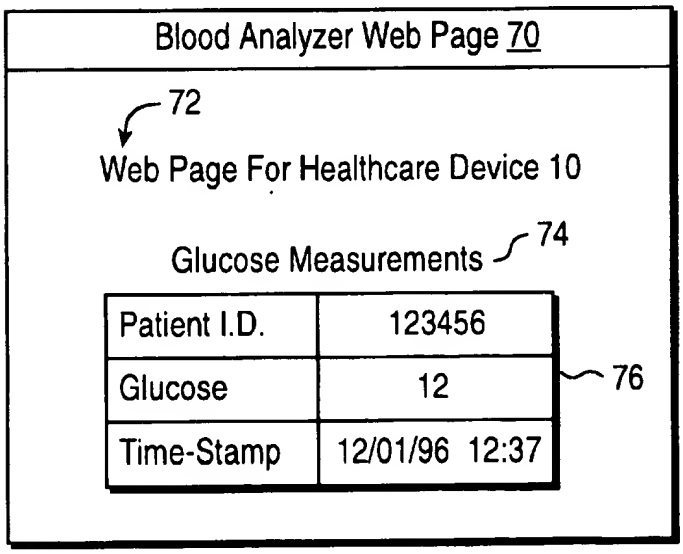

Blood Analyzer Web Page 70
72
Web Page For Healthcare Device 10
Glucose Measurements
74
Patient I.D. 123456
Glucose 12
Time-Stamp 12/01/96 12:37
76

FIG. 3

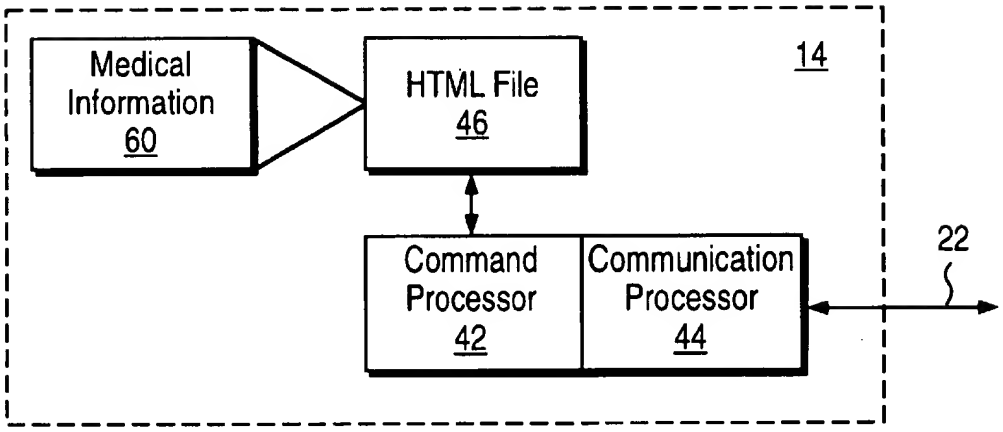
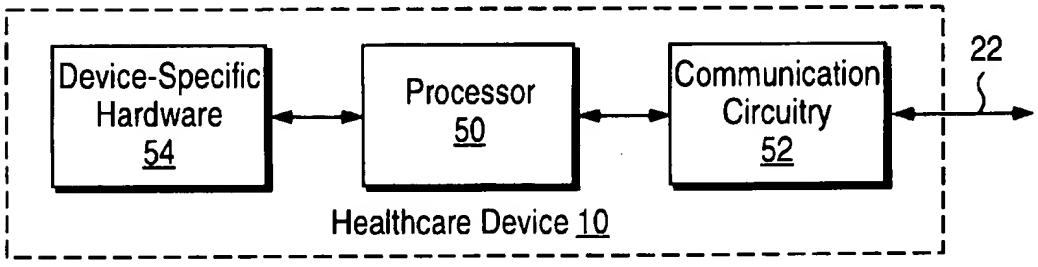

Medical Information 60
HTML File 46
14
Command Processor 42
Communication Processor 44
22

FIG. 4


Device-Specific Hardware 54
Processor 50
Communication Circuitry 52
22
Healthcare Device 10

UNIVERSALLY ACCESSIBLE HEALTHCARE DEVICES WITH ON THE FLY GENERATION OF HTML FILES

BACKGROUND OF THE INVENTION

1. Field of Invention

The present invention pertains to the field of healthcare devices. More particularly, this invention relates to healthcare devices which are universally accessible using open standard network protocols.

2. Art Background

A variety of devices for obtaining medical information pertaining to patients are commonly employed in hospitals and clinics. For example, blood analyzers are commonly used in hospitals and clinics to obtain blood chemistry measurements such as glucose level. Other devices include devices for measuring heart rate, blood pressure, and devices for recording electrocardiogram data. Such devices are hereinafter referred to as healthcare devices. Such healthcare devices include portable devices such as portable blood analyzers, etc.

Prior healthcare devices commonly provide an access mechanism for transferring the medical information contained therein to a computer system. Such an access mechanism usually facilitates distribution of the medical information by taking advantage of the display and storage capabilities of a computer system.

The access mechanism of prior healthcare devices usually requires a computer system having a proprietary interface which is designed specially for the particular healthcare device. Typically, such a proprietary interface includes specialized software that executes on the computer system. Typically, a healthcare worker accesses medical information from such a prior healthcare device by transporting the healthcare device to the special computer system, attaching the healthcare device to a docking station or standard mechanism such as an RS232 port of the special computer system, and then initiating a transfer from the healthcare device using specialized software executing on the computer system.

Unfortunately, such prior methods of accessing healthcare devices are usually not well suited to out of hospital or out of clinic environments such as a patient's home where computer systems with proprietary interfaces are usually not available. Moreover, the costs associated with equipping a location such as a patient's home with a specialized computer system for accessing information from healthcare devices is usually prohibitively expensive.

Such limitations on the ability to access medical information in certain environments usually limits the utility of prior healthcare devices. For example, a visiting nurse may collect glucose data from a patient in the patient's home using a prior portable blood analyzer. Typically, the obtained glucose data remains stored in the portable blood analyzer until the visiting nurse returns to the hospital or clinic and manually initiates the transfer of the stored data to a special computer system. Unfortunately, a doctor cannot read the glucose data obtained with such a prior portable blood analyzer while it is in transit between the patient's home and the hospital.

SUMMARY OF THE INVENTION

One object of the present invention is to provide universal access to information stored in healthcare devices.

Another object of the present invention is to reduce the cost of home healthcare monitoring by eliminating the requirement of having a proprietary software package for accessing medical information from healthcare devices.

A further object of the present invention is to reduce the overall cost of home healthcare monitoring by eliminating the need for having a personal computer in the home to access medical information from healthcare devices.

Another object of the present invention is to make the medical information contained in healthcare devices widely accessible and available sooner in comparison to prior systems that employ proprietary interfaces to personal computers.

These and other objects are provided by a healthcare device having a communication path and a server. The healthcare device generates a set of medical information and the server provides access to the medical information using an open standard network protocol on the communication path. The server packages the medical information in an Hyper-Text Markup Language (HTML) file which is transported according to the Hyper-Text Transfer Protocol (HTTP). The server functionality may be implemented with existing circuitry in the healthcare device such as an exiting processor and memory that normally perform device-specific functions, thereby avoiding the extra cost and space required for dedicated server hardware for the healthcare device.

The server functionality embedded in the healthcare device enables a web browser to access the medical information obtained by the healthcare device via a variety of communication routes including the world wide web of the Internet. The HTML and HTTP protocols inherent in web technology enable communication with existing web browsers independent of the platform that executes the web browser and independent of the location of the healthcare worker that uses the web browser to access the medical information.

Other features and advantages of the present invention will be apparent from the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described with respect to particular exemplary embodiments thereof and reference is accordingly made to the drawings in which:

FIG. **1** shows a healthcare device which is universally accessible via a communication network using open standard network protocols;

FIG. **2** illustrates a web page rendered by a web browser for an example HTML file that transports medical information from a healthcare device;

FIG. **3** illustrates a web server in a healthcare device which includes a command processor and a communication processor;

FIG. **4** illustrates one hardware embodiment of the healthcare device which includes a processor, a set of communication circuitry, and a set of device-specific hardware.

DETAILED DESCRIPTION

FIG. **1** shows a healthcare device **10** which is universally accessible via a communication network **30** using open standard network protocols. The healthcare device **10** includes a web server **14** that exchanges messages with web clients using the HTTP and HTML open standard protocols on the communication network **30**. The web server **14** handles HTTP commands received via the communication network **30** that specify a predetermined Universal Resource Locator (URL) for the healthcare device **10**. The HTTP

commands are used by web clients such as a web browser **40** to read medical information including measurement data and optional related information from the healthcare device **10**. The web server **14** packages the medical information into the HTML format and transfers the information to requesting web clients on the communication network **30** using the HTTP protocol.

In one embodiment, the communication network **30** represents world wide web communication which is enabled by Internet communication protocols including HTTP and HTML. The healthcare device **10** and the web browser **40** use communication paths **22** and **23**, respectively, for access to the Internet. The communication paths **22–23** may be direct Internet connections or connections to Internet Service Providers (ISPs) that in turn provide Internet access. The healthcare device **10** in this embodiment may be used to obtain measurements in a remote location from a hospital or clinic, such as a patient's home, and a doctor, nurse, or other healthcare worker located anywhere Internet access is available including a hospital or clinic may use the web browser **40** to access the obtained measurement data and related information from the healthcare device **10**.

In another embodiment, the communication network **30** is a local area network that supports Internet communication protocols including HTTP and HTML as well as underlying layers including Transmission Control Protocol/Internet Protocol (TCP/IP). The communication paths **22–23** may be coaxial communication links, power line communication links, twisted pair communication links, radio frequency communication links, infrared communication links, or any combination thereof. The healthcare device **10** may be used to obtain measurements in a remote location of a hospital or clinic, such as a hospital ward, and a doctor, nurse, or other healthcare worker may use the web browser **40** located elsewhere in the hospital or clinic can access the healthcare device **10** via the local area network **30** of the hospital or clinic.

In yet another embodiment, the communication network **30** is a wide area network or "intranet" of a hospital, clinic, or large healthcare organization which can extend beyond the walls of the particular organization. The healthcare device **10** may be used to obtain measurements in one branch location of the healthcare organization or in a patient's home, and a healthcare worker may use the web browser **40** located in another branch of the healthcare organization to access information from the healthcare device **10** using the intranet **30** of the healthcare organization.

The web browser **40** may be embodied in a computer system that executes web browser software. Such a computer system with web browser functionality may be realized by any one of a variety of available computer system platforms including Windows platforms, Macintosh platforms, Unix platforms as well as any other platform capable of executing web browser software that provides HTTP client functions and that renders HTML files.

The web browser **40** may also be embodied in a variety of other devices that provide HTTP client functions and that render HTML files. Such devices include specialized hardware designed for television or telephone systems as well as low cost web browser devices and devices referred to as network computers.

A healthcare worker enters a URL corresponding to the healthcare device **10** into the web browser **40**. In response, the web browser **40** transfers an HTTP command which includes the entered URL over the communication network **30**. The HTTP command used by the web browser **40** to access medical information from the healthcare device **10** may be an HTTP GET, an HTTP POST, or an HTTP PUT command.

The web server **14** in the healthcare device **10** receives the HTTP command via the communication path **22** and recognizes the URL contained therein. In response, the web server **14** packages internally obtained medical information into an HTML file and transfers the HTML file containing the medical information to the web browser **40** using the HTTP protocol. The web browser **40** receives the HTML file and renders the medical information contained therein on a display.

In one embodiment, the healthcare device **10** is a portable blood analyzer. The healthcare device **10** includes modules for measuring aspects of blood chemistry such as glucose level as well as circuitry for storing blood chemistry measurement data in digital form. The healthcare device **10** also includes timing circuitry for generating time stamp data and further includes input circuitry such as a keypad that enables entry of patient identifiers and other related information for the obtained blood chemistry measurements. The web server **14** enables universal access to the blood chemistry data and related information via the communication network **30** using HTML and HTTP protocols.

In another embodiment, the healthcare device **10** is a portable electrocardiogram recorder having sensing mechanisms for obtaining electrocardiogram readings and electronic hardware and software for digitizing the recorded data. The web server **14** enables universal access to the recorded electrocardiogram data and related information using HTML and HTTP protocols. The patient can trigger data recording using a variety of triggering mechanisms or loops of electrocardiogram data may be recorded. The electrocardiogram device **10** may also provide real-time electrocardiogram data to an external web browser using HTML and HTTP protocols.

In another embodiment, the healthcare device **10** is a spirometer for measuring the efficiency of a patient's lungs. The web server **14** enables universal access to data indicating lung efficiency and related information stored in the healthcare device **10**.

In yet another embodiment, the healthcare device **10** is a portable blood pressure measurement instrument. The healthcare device **10** includes mechanisms for measuring blood pressure as circuitry for storing blood pressure measurements. The web server **14** enables universal access to the blood pressure data and related information using HTML and HTTP protocols.

In another embodiment, the healthcare device **10** is a portable blood alcohol measurement instrument with mechanisms for measuring blood alcohol content as well as circuitry for storing measurements. The web server **14** provides universal access to the blood alcohol measurements and related information using HTML and HTTP protocols.

In another embodiment, the healthcare device **10** is a weight scale which is useful for monitoring changes in a patient's body weight. The healthcare device **10** includes mechanisms for weight measurement and circuitry for storing measurements. The web server **14** enables universal access to the weight measurement data and related information using HTML and HTTP protocols.

In yet another embodiment, the healthcare device **10** is an instrument for analyzing fecal blood for the detection of colon cancer. The web server **14** enables universal access to the obtained measurements using HTML and HTTP protocols.

The following is an example HTML file generated by the web server **14** in response to an HTTP GET command in an embodiment wherein the healthcare device **10** is a blood analyzer.

```
<TITLE>Blood Analyzer Web Page</TITLE>
<H1>Web page for healthcare device 10</H1>
<HR>
<table border>
<caption>Glucose Measurments </caption>
<TR>
<TD>Patient I.D.</TD>123456</TD>
</TR>
<TR>
<TD>Glucose</T1><TD>12</TD>
</TR>
<TR>
<TD>Time-Stamp</TD><TD>Dec. 1, 1996 12:37</TD>
</TR>
</TABLE>
<HR>
```

FIG. **2** illustrates a web page rendered by the web browser **40** for the example HTML file shown above. The web page for the example blood analyzer device **10** includes a page title **70**, a header section **72**, a table section **76** containing the medical information obtained from the blood analyzer device **10**, and a table header **74**.

The medical information shown including Patient I.D. of 123456, Glucose of 12, and Time-Stamp of Dec. 10, 1996 12:37 was generated in the blood analyzer device **10** and packaged into the HTML file shown above by the web server **14**. The decoding and rendering of the web page shown is a function of the web browser **40** according to standard formatting protocols for HTML files.

The web server **14** may also implement any one of a variety of methods for providing secure access to the medical measurements and related information stored in the healthcare device **10**. Such mechanisms include public or private key encryption of the medical data and related information transported in the HTML file generated by the web server **14**.

In addition, access to the healthcare device **10** may be password protected and may require that a smartcard be used at the web browser **40** to enable access. For example, the HTTP command used to request the medical information may be required to include a predetermined password. The web server **14** examines the password and either ignores the HTTP command or transfers a reject message to the requesting web client if the password is missing or invalid.

FIG. **3** illustrates the web server **14** which includes a command processor **42** and a communication processor **44**. The communication processor **44** is a combination of hardware and software for transferring messages via the communication path **22** using the HTTP protocol. The communication processor **44** relays received HTTP commands from requesting web clients onto the command processor **42**.

The command processor **42** is a combination of hardware and software that generates an HTML file **46** and writes a set of medical information **60** obtained in the healthcare device **10** into the HTML file **46**. The medical information **60** is generated by the healthcare device **10** according to its predetermined device-specific function for the particular embodiment. The communication processor **44** transfers the HTML file **46** with the medical information **60** to the requesting web client using the HTTP protocol.

In one embodiment, the command processor **42** generates the HTML file **46** on the fly in response to an HTTP command from a requesting web client. This embodiment offers the advantage of not requiring that memory space be allocated in the medical device **10** for storing the HTML file **46**.

In another embodiment, the command processor **42** obtains the medical information **60** and then generates the HTML file **46** prior to receipt of an HTTP command from a requesting web client.

FIG. **4** illustrates one hardware embodiment of the healthcare device **10** which includes a processor **50**, a set of communication circuitry **52**, and a set of device-specific hardware **54**. The processor **50** includes memory for storing data and software code. Alternatively, a separate memory may be provided to store data and software code.

The device-specific hardware **54** represents the mechanisms necessary to perform the device-specific medical function of the healthcare device **10**. Such mechanisms may include chemical, mechanical, electrical, or electronic mechanisms or any combination thereof. The device-specific hardware **54** may also include the electronic circuitry for digitizing and storing obtained measurements and for displaying the obtained measurements with a display mechanism in the healthcare device **10**. Alternatively, the functions of digitizing and storing measurement data may be implemented with the processor **50**.

In one embodiment, the processor **50** performs device-specific functions for the healthcare device **10** in combination with the device-specific hardware **54**. For example, the processor **50** may execute code for determining blood glucose levels using chemical sensing mechanisms provided by the device-specific hardware **54**. The processor **50**, the same processor used for device-specific functions, also executes code for performing functions associated with the web server **14** such as obtaining the medical information **60** from the device-specific hardware **54** and generating the HTML file **46** and performing HTTP communication via the communication path **22** including TCP/IP layers.

In other embodiments, the processor **50** may be added to the healthcare device **10** to perform the command processor **42** and communication processor **44** functions of the web server **14** while a separate processor in the device-specific hardware **54** performs the device-specific medical functions.

The communication circuitry **52** enables communication via the communication path **22** using the HTTP open standard protocol. The communication circuitry **52** may be circuitry for communicating over local area networks, or telephone lines including cellular telephone links, or serial communication links, or parallel communication links, or power line communication links, or radio, cellular radio, paging or infrared communication links as is appropriate to a particular embodiment. The communication circuitry **52** in one embodiment includes a processor and code for communicating using the HTTP protocol and underlying TCP/IP communication protocols. In other embodiments, such protocol handling may be provided by the processor **50** with associated executable code.

The foregoing detailed description of the present invention is provided for the purposes of illustration and is not intended to be exhaustive or to limit the invention to the precise embodiment disclosed. Accordingly, the scope of the present invention is defined by the appended claims.

What is claimed is:

1. A method for accessing medical information in a healthcare device, comprising the steps of:

receiving an HTTP command from a web client wherein the command includes a URL that corresponds to the healthcare device;

generating an HTML file that contains the medical information and transferring the HTML file to the web client in response to the HTTP command such that the HTML file is generated on the fly thereby not using memory space in the healthcare device.

2. The method of claim 1, further comprising the step of encrypting the medical information contained in the HTML file.

3. The method of claim 1, wherein the step of transferring the medical information is performed only if the HTTP command includes a predetermined password.

4. A portable healthcare device, comprising:

a communication path;

an existing processor and an existing memory;

a set of device-specific hardware for generating a set of medical information; and

a server which is implemented using the existing processor and the existing memory such that the server encrypts and transfers the medical information via the communication path in response to a command received via the communication path using an open standard network protocol on the communication path wherein the medical information is carried in a file having a format that conforms to the open standard network protocol and wherein the server generates the file on the fly such that the file does not use space in the existing memory.

5. The portable healthcare device of claim 4, wherein the command is an HTTP command and the file is an HTML file containing the medical information.

6. The portable healthcare device of claim 4, wherein the server transfers the file containing the medical information only if the command includes a predetermined password.

7. The portable healthcare device of claim 4, wherein the existing processor and the existing memory are also used to implement the open standard network protocol on the communication path.

8. A healthcare device, comprising:

a set of device-specific hardware for generating a set of medical information;

a communication path; and

a server coupled to the communication path that obtains the medical information from the device-specific hardware and transfers the medical information via the communication path using an open standard network protocol on the communication path wherein the medical information is carried in a file having a format that conforms to the open standard network protocol and wherein the server generates the file on the fly in response to a command received via the communication path such that the file does not use memory space in the healthcare device.

9. The healthcare device of claim 8, wherein the file is an HTML file such that the server obtains the medical information from the device-specific hardware and generates an HTML file that contains the medical information and transfers the HTML file over the communication path in response to the HTTP command received over the communication path that specifies a URL for the medical device.

10. The healthcare device of claim 9, wherein the server includes means for encrypting the medical information contained in the HTML file.

11. The healthcare device of claim 9, wherein the server transfers the HTML file containing the medical information only if the HTTP command includes a predetermined password.

12. The healthcare device of claim 8, wherein the medical information comprises a set of measurement data generated by the device-specific hardware of the healthcare device.

13. The healthcare device of claim 12, wherein the medical information further comprises a patient identifier corresponding to the measurement data.

14. The healthcare device of claim 12, wherein the medical information further comprises a time-stamp corresponding to the measurement data.

15. The healthcare device of claim 12, wherein the measurement data comprises a set of blood analysis data.

16. The healthcare device of claim 12, wherein the measurement data comprises a set of electrocardiogram recorder data.

17. The healthcare device of claim 12, wherein the measurement data comprises a set of lung efficiency data.

18. The healthcare device of claim 12, wherein the measurement data comprises a set of blood pressure data.

19. The healthcare device of claim 12, wherein the measurement data comprises a set of blood glucose data.

20. The healthcare device of claim 12, wherein the measurement data comprises a set of blood alcohol data.

21. The healthcare device of claim 12, wherein the measurement data comprises a set of fecal blood data.

22. The healthcare device of claim 12, wherein the measurement data comprises a set of body weight data.

* * * * *

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Groezinger

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[54] **METHOD AND SYSTEM FOR REMOTELY VIEWING AND CONFIGURING OUTPUT FROM A MEDICAL IMAGING DEVICE**

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[21] Appl. No.: **09/023,551**

[22] Filed: **Feb. 13, 1998**

[51] **Int. Cl.**[7] **A61B 5/00**; A61B 8/00

[52] **U.S. Cl.** **600/407**; 600/437; 128/922

[58] **Field of Search** 600/407, 425, 600/300, 437; 705/3; 128/922

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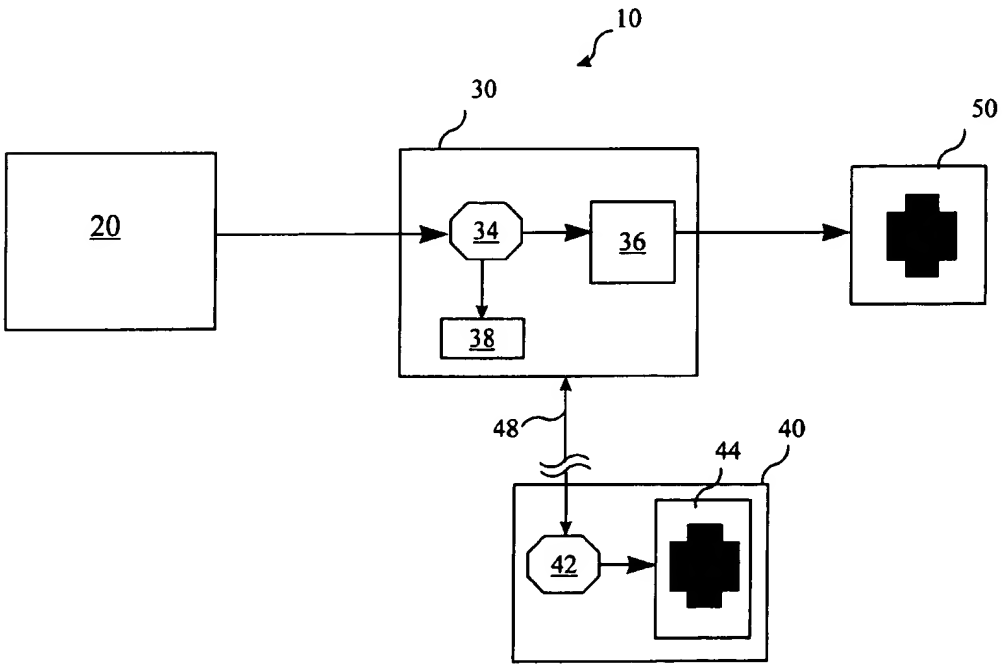
[57] **ABSTRACT**

A method and system for remotely viewing and configuring output from a medical imager is described. A medical imager having an embedded web server generates an HTML document according to medical images received from various medical modalities. Imaging information is communicated in the HTML document to allow a remote machine to manipulate the images and display the images in a manner that accurately represents their printed output by the imager. The invention thus provides accurate viewing of the medical images from a remote machine and facilitates remote configuration of the medical imager. Other advantages include the ability to easily select conversion mechanisms best suited for specific requirements of the hospital's medical modalities without traveling to the hospital and burdening medical staff. The present invention also allows for remote monitoring of operation statistics such as usage of imaging media and other supplies.

20 Claims, 2 Drawing Sheets



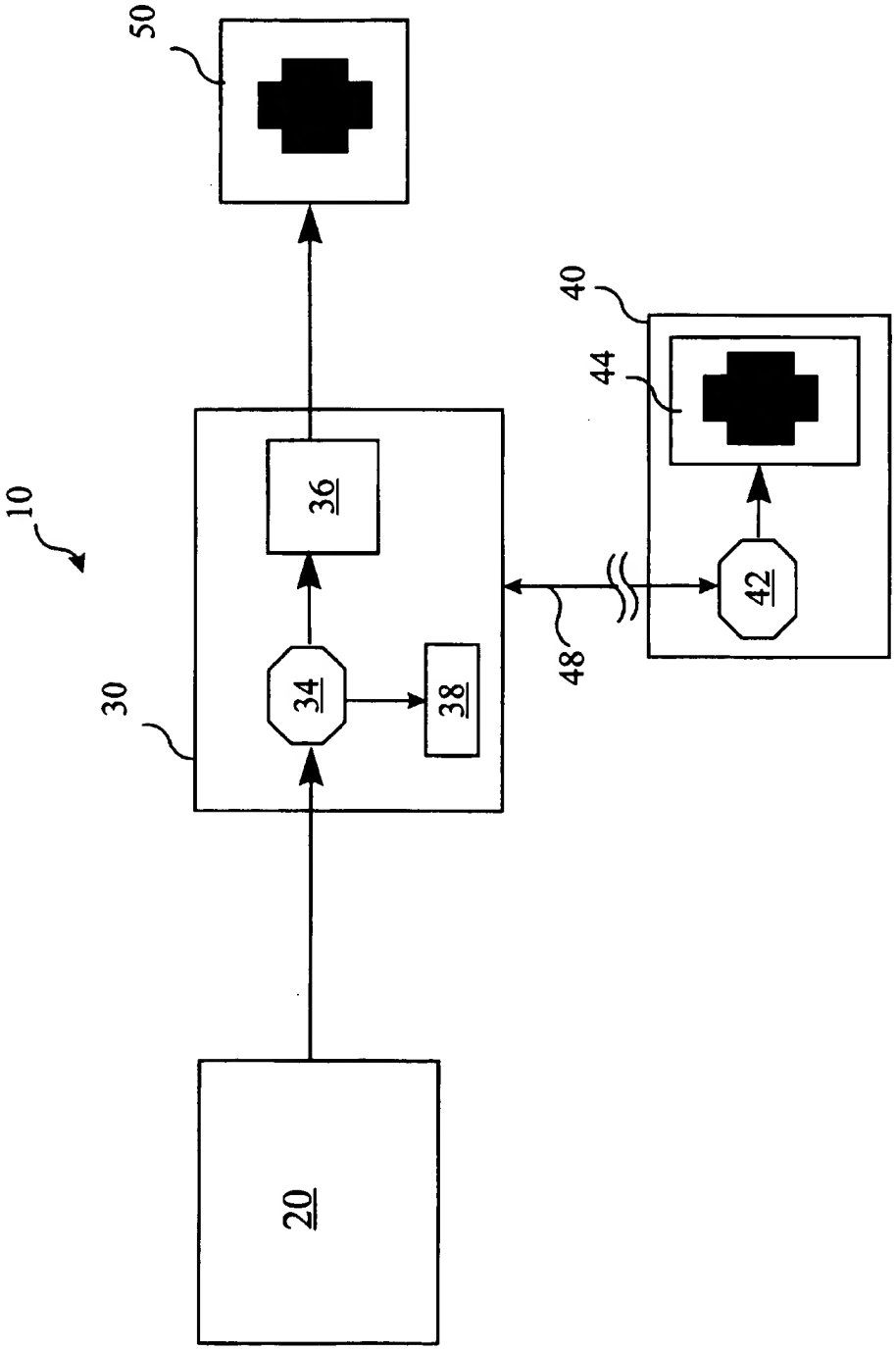


FIG 1

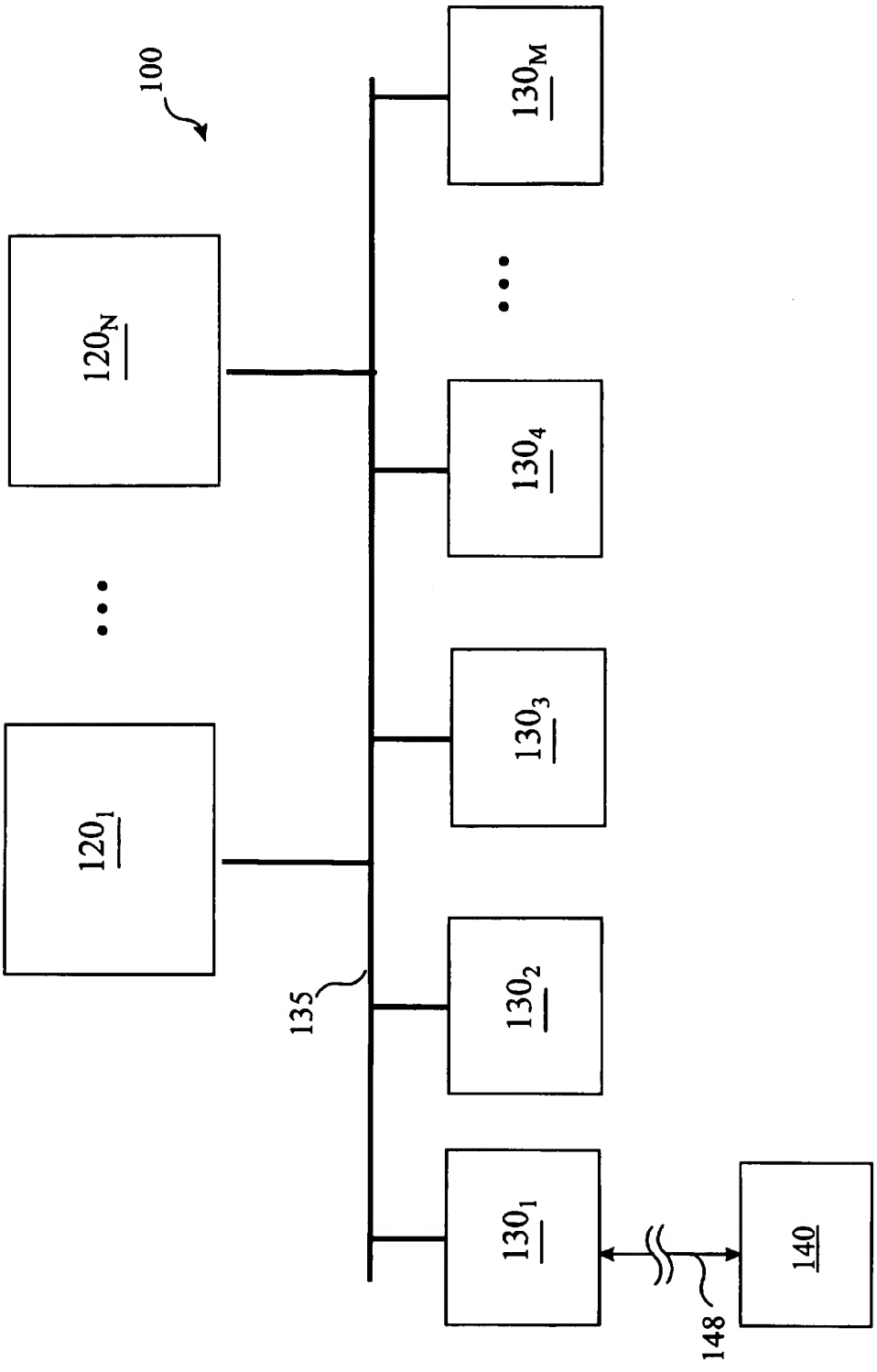


FIG 2

METHOD AND SYSTEM FOR REMOTELY VIEWING AND CONFIGURING OUTPUT FROM A MEDICAL IMAGING DEVICE

FIELD OF THE INVENTION

This invention relates generally to the field of remote diagnostics including remote maintenance and configuration of a medical imaging device. More particularly, the invention is directed to a method and system for remotely viewing and configuring output from a medical imaging device.

BACKGROUND

A medical imaging system typically includes at least one medical modality that generates input pixel data representative of an image and a medical imager that forms a visible representation of the image based on the input pixel data. In a medical imaging system, the medical modality may include a diagnostic modality, such as a magnetic resonance (MR), computed tomography (CT), conventional radiography (X-ray), direct radiography (DR) or ultrasound imaging device. The input pixel data generated by the medical modality corresponds to a plurality of pixels in the original image and represents an optical density associated with the respective pixel. The medical imager processes the input pixel data to generate output image data. For example, in a continuous tone laser imager, the output image data represents exposure levels necessary for a scanning assembly to accurately reproduce the original image on an imaging element. The scanning laser exposes imaging media, such as a photosensitive film, to form the visible representation of the image. The output image data is used to modulate the intensity of the scanning laser while exposing the imaging media, thereby forming the visible representation of the original image. Other medical imagers use different imaging techniques to form output images such as direct thermal imaging, ablation imaging, dye transfer, ink jet, dye sublimation and thermal mass transfer.

In order to form an accurate reproduction of the input image, the medical imager applies a conversion mechanism, such as a transfer function or a lookup table, to convert the input pixel data to the output image data. A transfer function mathematically characterizes the relationship between the input pixel data and the output image data while a lookup table maps discrete input pixel data to output image data, thereby eliminating mathematical calculations. A user selects an appropriate conversion mechanism in order to enhance a desired characteristic of the input image such as contrast or density. In this fashion, the user selects a particular conversion mechanism that best highlights the important diagnostic information conveyed by the image. In other words, the conversion mechanism generates the output image data in a manner that accents the desired visual characteristic.

If the medical imager fails to produce the appearance characteristic desired by a system user, the diagnostic value of the resulting images can be impaired. The selection of appropriate conversion mechanisms is a time consuming task that requires considerable skill and effort. A service technician is often called upon to assist hospitals in selecting appropriate lookup tables and transfer functions based on the specific requirements of the hospital and the type of diagnostic images commonly produced by the hospital's medical modalities. Because of the continual demand for a hospital's medical imaging system, a lengthy service call to properly configure the medical imager may be a tremendous burden on the hospital's medical staff as well as the service technician. Accordingly, there is a need for an improved medical imaging system that is easily configured and maintained without interfering with hospital staff.

SUMMARY OF THE INVENTION

As explained in detail below, the present invention is directed to a method and system for remotely viewing and configuring output from a medical imaging device. In one aspect, the invention provides for more accurate display of medical images on a remote machine, thereby facilitating remote configuration of the medical imager. The more accurate display allows a service technician to more easily configure the medical imaging device without traveling to the hospital and burdening medical staff, including selecting conversion mechanisms best suited for highlighting various characteristics of the images.

In one embodiment, the invention is a medical imaging system including a medical modality for generating an input image having input pixel data. A medical imager is communicatively coupled to the medical modality and receives the input image from the medical modality and forms an output image on an imaging element based on the input pixel data of the input image. The medical imager includes an internal web server for generating an HTML document containing pixel data based on the input pixel data. A client machine is communicatively coupled to the medical imager and receives the HTML document from the medical imager for displaying the pixel data contained within the HTML document. The interface may be a conventional web browser or may be a custom interface for displaying the pixel data of the HTML document. In this manner, the input images received by the medical imager are accurately displayed by the remote client machine, thus allowing a service technician to easily configure the medical imager without traveling to the hospital and burdening medical staff.

The present invention facilitates the remote display of images that more accurately represent the output of a medical imager. For example, the web server of the medical imager may generate an HTML document containing output image data generated when the medical imager applies a conversion mechanism, such as a lookup table or transfer function, to the input pixel data. Alternatively, the web server may generates an HTML document containing the input image data such that the client machine applies a conversion mechanism to the contained pixel data of the HTML document for generating display image data for displaying on the interface. In this manner, image displayed by the client machine more accurately represents the output image formed by the medical imager. According to yet another feature, the HTML document does not contain pixel data but contains a hypertext link to the input images stored on the medical imager, thus allowing the service technician to selectively receive input images for remote viewing. Additionally, the HTML document may contain operating statistics such as a count of the number of imaging elements used by the medical imager.

According to another aspect of the invention, the medical imaging system may include a network such that the medical imager is connected to a second medical imager. The second medical imager generates a second HTML document and communicates the second HTML document to the client machine through the network. Thus, similar to the manner described above, a service technician is able to remotely view and configure output from a plurality of medical imagers.

In yet another embodiment, the invention is a method for configuring a medical imager having a plurality of stored

conversion mechanisms. A web server of the medical imager is accessed via a web browser executing on a remote client machine communicatively coupled to the medical imager. Through the web browser, the medical imager is commanded to receive an input image having input pixel data and imaging information from a medical modality. The medical imager is then commanded to generate an HTML document containing the imaging information and pixel data representative of the input pixel data of the input image. The web browser receives the HTML document from the web server of the medical imager and displays the contained pixel data of the HTML document on the client machine according to the imaging information of the HTML document. One of the plurality of the conversion mechanisms of the medical imager is selected based on the displayed pixel data. Finally, the medical imager is commanded to apply the selected conversion mechanism to subsequent input images from the medical modality to form output images on an imaging element.

These and other features and advantages of the invention will become apparent from the following description of the preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating one embodiment of a medical imaging system incorporating a method and system for remotely viewing and configuring output of a medical imager in accordance with the present invention; and

FIG. **2** is a block diagram illustrating one embodiment of a medical imaging system having a plurality of networked medical imagers and incorporating the present invention.

DETAILED DESCRIPTION

In the following detailed description, references are made to the accompanying drawings which illustrate specific embodiments in which the invention may be practiced. Electrical, mechanical and structural changes may be made to the embodiments without departing from the spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense and the scope of the present invention is defined by the appended claims and their equivalents.

FIG. **1** illustrates medical imaging system **10** in block diagram form. Medical imaging system **10** includes medical modality **20**, medical imager **30**, client machine **40** and imaging element **50**. Medical modality **20** generates an input image having input pixel data and may be any suitable diagnostic modality such as a magnetic resonance (MR), computed tomography (CT), digital radiography (DR) or ultrasound imaging device. Each of the input pixel data corresponds to one of a plurality of pixels in the original input image, and represents an optical density associated with the respective pixel. Medical modality **20** communicates the generated input image to medical imager **30** for forming a representative output image on imaging element **50**. Typically, medical modality **20** communicates the input pixel data of the input image as well as imaging information that specify characteristics of the modality or operations to be performed by medical imager **30** on the communicated input pixel data.

Medical imager **30** is communicatively coupled to medical modality **20** and may be any medical imaging device suitable for receiving the input image from medical modality **20** and forming an output image on imaging element **50**. In one embodiment medical imager **30** is a continuous tone laser imager. Furthermore, imaging element **50** may be photographic such that medical imager **30** includes a processor station (not shown) for chemical processing and developing of the output image formed on imaging element **50**. In another embodiment, imaging element **50** may be photothermographic which can be thermally processed and need not be chemically processed.

Prior to forming the output image on imaging element **50**, controller **34** of medical imager **30** performs a number of operations on the input pixel data according to the imaging information received from medical modality **20**. For example, medical imager **30** may rotate or magnify the input pixel data. Additionally, controller **34** applies at least one of a plurality of conversion mechanisms to convert the input pixel data to output image data for forming on imaging element **50**. Typically, controller **34** applies a user selected conversion mechanism in order to achieve a desired appearance characteristic such as contrast or density. In this manner, the conversion mechanism generates the output image data necessary to produce the appearance characteristic desired by the user. For example, in one embodiment controller **34** applies a lookup table to convert the received input pixel data to output image data. In another embodiment, controller **34** applies a transfer function to the input pixel data in order to calculate a corresponding output image data.

After generating output image data from the input pixel data, controller **34** commands medical imager **30** such that radiation source **36** forms a representation of the input image on imaging element **50**. In one embodiment, radiation source **36** comprises a laser diode scan module for emitting a suitable beam of radiation. Other imaging processes are also suitable for the present invention including direct thermal imaging, ablation imaging, dye transfer, ink jet, dye sublimation and thermal mass transfer. Furthermore, controller **34** represents any logic circuit suitable for device control. For example, controller **34** may be an embedded microprocessor having RAM for data manipulation and general program execution.

In conventional imaging systems, a user typically selects an appropriate conversion mechanism for the medical imager in order to produce an output image having high diagnostic value. As discussed above, selection of the appropriate conversion mechanism is based in part on characteristics of input images and the medical modalities. The selection may requires great time and effort from hospital personnel and service technicians. For these reasons, according to one feature of the present invention a service technician can configure medical imager **30** by accessing medical imager **30** from client machine **40**. More specifically, a service technician can perform a variety of configuration and maintenance operations on medical imager **30** from client machine **40** via communications link **48**. In one embodiment, client machine **40** is remote from the hospital and communications link **48** allows the service technician to easily configure medical imager **30** using a modem or other communications device. In another embodiment, medical imager **30** and client machine **40** are co-located within a hospital and communications link **48** directly connects the two devices.

Client machine **40** is a computer configured for executing suitable communication protocols, such as the Transmission Control Protocol/Internet Protocol (TCP/IP) and the File Transport Protocol (FTP), over communications link **48**. Upon accessing medical imager **30** from client modality **40**, the service technician commands web server **38** of medical imager **30** to generate an HTML document based on the

input image received from medical modality **20**. Web server **38** may generate the HTML document in one of several way. In one embodiment, web server **38** generates an HTML document containing the input pixel data as well as the imaging information received from medical modality **20**. In another embodiment, controller **34** applies imaging operations and selected conversion mechanisms to the input pixel data based on the imaging information of the input image such that web server **38** generates an HTML document containing output image data. This embodiment is beneficial because client machine **40** need not apply imaging operations to the pixel data contained within the HTML document prior to displaying the pixel data on interface **44**. In yet another embodiment, web server **38** generates an HTML document containing hypertext links to the input images stored by medical imager **30**. This embodiment is beneficial in that a service technician can select the images to be remotely viewed, thereby limiting the amount of communicated pixel data.

Upon receiving the HTML document generated by web server **38**, controller **42** of client machine **40** manipulates the contained pixel data according to any imaging operations specified within the HTML document. For example, controller **42** applies any conversion mechanisms communicated by the HTML document, thereby converting the contained pixel data to display image data for displaying on interface **44**. In one embodiment, client machine **40** maintains a plurality of conversion mechanisms and selects an appropriate mechanisms based on the imaging information contained within the HTML document.

By application of a conversion mechanism to the contained pixel data similar to the mechanism applied by medical imager **30**, the image displayed on interface **44** more accurately represents the output image formed on imaging element **50**. Because of the invention more accurately displays medical images, the service technician can easily select conversion mechanisms best suited for the specific characteristics of the images produced by the hospital's medical modalities without traveling to the hospital and involving medical staff.

In addition to pixel data and imaging information, web server **38** may generate the HTML document to include various operating statistics. For example, in one embodiment processor **34** maintains a count of the number of imaging elements used by medical imager **30** and communicates the count via the generated HTML document. Based on the operating statistics, client machine **40** can be used to remotely determine whether a service call is needed or whether new supplies should be sent to the hospital.

FIG. **2** is a block diagram illustrating one embodiment of a medical imaging system **100** having a plurality of M medical imagers **130** and a plurality of N medical modalities **120** interconnected by network **135**. The networked configuration allows images produced by any medical modality **120** to be routed to any available medical imager **130**. As in imaging system **10** of FIG. **1**, medical modalities **120** communicate input images to medical imagers **130** for forming on imaging elements. Unlike imaging system **10**, medical modalities **120** communicates the input images over network **135** using a suitable network protocol. For example, in one embodiment, network **135** is an Ethernet network using twisted pair, coaxial cable or fiber-optic connection. Furthermore, medical imagers **130** and medical modalities **120** implement a common communications protocol. In one embodiment, medical modalities **120** exchange data and information with medical imagers **130** using a data communications protocol developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) known as the DICOM protocol. Typically, the protocol may be implemented using a TCP/IP connection between medical modalities **120** and medical imager **130** over network **135**.

Configuration of each medical imager **130** is complicated due to the plurality of medical modalities **120**. Each medical modality may be of different type, such as magnetic resonance (MR), computed tomography (CT), digital radiography (DR) or ultrasound. Each medical modality **120** may, therefore, have different imaging characteristics and features. Each medical imager **130** may need to apply different conversion mechanisms to input images received from different medical modalities **130** in order to form output images having high diagnostic value. The potential for a wide variety of medical modalities **120** further increases the time and effort required by hospital personnel and service technicians to configure medical imagers **130**. Thus, according to one feature of the present invention, a service technician can configure each medical imager **130** by first accessing medical imager $\mathbf{130}_1$ from client machine **140**. In this manner, a service technician can perform a variety of configuration and maintenance operations on each medical imager **130** via communications link **148** and network **135**.

Similar to client machine **40** of FIG. **1**, client machine **140** of FIG. **2** is a computer configured for executing suitable communication protocols, such as TCP/IP and FTP, over communications link **148**. Upon accessing medical imager $\mathbf{130}_1$ from client machine **140**, the service technician may initiate configuration of medical imager $\mathbf{130}_1$ by commanding medical imager $\mathbf{130}_1$ to request an input image from one of the plurality of medical modalities **120**. Upon receiving the request the selected medical modality **120** will produce a test image. Alternatively, hospital personnel or a service technician can manually initiate the generation of an input image by one of the medical modalities **120**. The service technician commands a web server (not shown) of medical imager $\mathbf{130}_1$ to generate an HTML document based on the test input image received from the selected medical modality **120**. As yet another alternative, the service technician may command the web server of medical imager $\mathbf{130}_1$ to generate the HTML document based on actual diagnostic input images received from a medical modality **120**. Upon receiving the HTML document generated by the web server of medical imager $\mathbf{130}_1$, client machine **140** manipulates the contained pixel data according to any imaging operations specified within the HTML document, thereby converting the contained pixel data to display image data. By application of imaging operations, such as conversion mechanism, the image displayed by client machine **140** more accurately represents the output image formed by medical imager $\mathbf{130}_1$. In this manner, client machine **140** allows a service technician to display an image that closely approximates the output image formed by medical imager $\mathbf{130}_1$.

Because each medical imager **130** is connected via network **135** and includes an internal web server, the service technician is able to remotely access each of the plurality of medical imagers **130** from client machine **148**. In other words, by accessing medical imager $\mathbf{130}_1$ via communications link **148**, client machine **140** is able to communicate with any medical imager **130** connected to network **135**. The service technician is able to communicate with the internal web server of each medical imager **130** and configure each medical imager **130** according to the process described above. In this fashion the invention facilitates remote viewing of the medical images produced by a plurality of medical modalities. The accuracy and convenience of the present

invention allow a service technician to select conversion mechanisms best suited for the each medical modality used by the hospital without traveling to the hospital. Furthermore, based on communicated statistics as described above, the service technician can remotely determine whether a service call is needed for any of the medical imagers or whether new supplies should be sent to the hospital. This application is intended to cover any adaptations or variations of the present invention. It is manifestly intended that this invention be limited only by the claims and equivalents thereof.

I claim:

1. A medical imaging system comprising:

a medical modality for generating an input image having input pixel data and imaging information;

a medical imager communicatively coupled to the medical modality for receiving the input image from the medical modality, wherein the medical imager selects a conversion mechanism in order to enhance a desired characteristic of the input image including one of contrast or density from a first plurality of stored conversion mechanisms based on the imaging information and applies the selected conversion mechanism to the input pixel data to generate output pixel data for forming an output image on an imaging element, and further wherein the medical imager includes a web server for generating an HTML document containing the imaging information and pixel data representative of the input pixel data; and

a client machine communicatively coupled to the medical imager for receiving the HTML document form the medical imager, wherein the client machine includes an interface for displaying the pixel data contained within the HTML document.

2. The system of claim 1, wherein the interface is a web browser.

3. The system of claim 1, wherein the pixel data of the HTML document is a copy of the output image data.

4. The system of claim 1, wherein the pixel data of the HTML document is a copy of the input image data.

5. The system of claim 4, wherein the client machine includes a second plurality of stored conversion mechanisms, and further wherein the client machine selects a conversion mechanism of the second plurality of conversion mechanisms based on the image information of the HTML and applies the selected conversion mechanism of the second plurality of conversion mechanisms to the contained pixel data of the HTML document to generate display image data for displaying on the interface.

6. The system of claim 5, wherein the conversion mechanism of the medical imager and the conversion mechanism of the client machine each include at least one lookup table.

7. The system of claim 5, wherein the conversion mechanism of the medical imager and the conversion mechanism of the client machine each include at least one transfer function.

8. The system of claim 4, wherein the web server communicates the selected conversion mechanism of the first plurality of conversion mechanisms to the client machine, and further wherein the client machine applies the selected conversion mechanism to the contained pixel data for generating display image data for displaying on the interface.

9. The system of claim 1, wherein the HTML document contains operating statistics of the medical imager including at least a count of used imaging elements.

10. The system of claim 1, wherein the medical imager includes a modem for communicating with the client machine.

11. The system of claim 1, wherein the client machine and the medical imager communicate using the Transmission Control Protocol (TCP) and the Internet Protocol (IP).

12. The system of claim 1, wherein the HTML document received by the client machine contains a hypertext link for receiving the contained pixel data from the medical image.

13. The system of claim 1, wherein the medical imager is connected to a network having at least a second medical imager, and further wherein the second medical imager generates a second HTML document and communicates the second HTML document to the client machine through the network.

14. A medical imaging system comprising:

a plurality of medical modalities for generating input images having input pixel data;

a plurality of medical imagers for forming output images based on the input pixel data of the input images, wherein the medical imagers and the medical modalities are interconnected by a network for communicating the input images form the medical modalities to the medical imagers, wherein each medical imager applies a conversion mechanism in order to enhance a desired characteristic of the input image, including one of contrast or density to the input pixel data to generate output image data for forming on the image element, and further wherein the pixel data of the HTML document is a copy of the output image data.

15. The system of claim 14, wherein the interface is a web browser.

16. The system of claim 14, wherein the pixel data of the HTML document is a copy of the input image data.

17. The system of claim 16, wherein the client machine stores a plurality of conversion mechanisms and applies at least one conversion mechanism to the contained pixel data of the HTML document to generate display image data for displaying on the interface.

18. The system of claim 16, wherein the web server communicates a conversion mechanism to the client machine, and further wherein the client machine applies the conversion mechanism to the contained pixel data for generating display image data for displaying on the interface.

19. A method for configuring a medical imager having a plurality of stored conversion mechanisms in order to enhance a desired characteristic of the input image including one of contrast or density comprising the steps of;

accessing a web server of the medical imager with a web browser executing on a remote client machine communicatively coupled to the medical imager;

commanding the medical imager to receive an input image having input pixel data and image information from a medical modality;

commanding the medical imager to generate an HTML document containing the imaging information and pixel data representative of the input pixel data of the input image;

receiving the HTML document from the web server of the medical imager;

selecting one of the plurality of the conversion mechanisms of the medical imager based on the pixel data and the imaging information of the HTML document; and

commanding the medical imager to apply the selected conversion mechanism to subsequent input images from the medical modality to form output images on an imaging element.

20. The method of claim 19, wherein the selecting step includes the step of displaying the contained pixel data of the HTML document on the client machine according to the imaging information of the HTML document.

* * * * *

US006032119A

United States Patent [19]

Brown et al.

[11] Patent Number: 6,032,119

[45] Date of Patent: Feb. 29, 2000

[54] **PERSONALIZED DISPLAY OF HEALTH INFORMATION**

[75] Inventors: **Stephen J. Brown**, Mountain View, Calif.; **Erik K. Jensen**, Stockton, N.J.

[73] Assignee: **Health Hero Network, Inc.**, Mountain View, Calif.

[21] Appl. No.: **08/784,740**

[22] Filed: **Jan. 16, 1997**

[51] **Int. Cl.**[7] **G06F 15/42**

[52] **U.S. Cl.** **705/2**; 705/9; 395/500; 600/300; 600/301; 600/483; 177/25.19

[58] **Field of Search** 600/300; 177/25.19; 705/2, 9; 395/500

[56] **References Cited**

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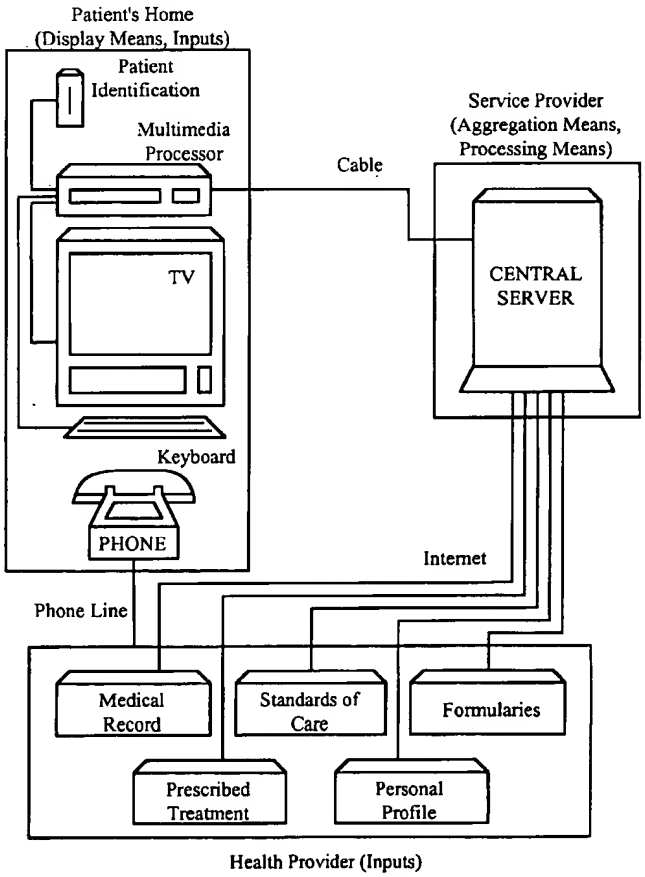
Primary Examiner—Allen R. MacDonald
Assistant Examiner—Jagdish Patel
Attorney, Agent, or Firm—Lumen Intellectual Property Services

[57] **ABSTRACT**

Delivery of health information to a patient suffering from a chronic condition is personalized by displaying the health information directly on a customized image of a body. The patient's medical record, standards of care for the condition, prescribed treatments, and patient input are applied to a generalized health model of a disease to generate a personalized health model of the patient. The personalized health model comprises an HTML file encoding an image map of a body. The body image illustrates the health condition of the individual patient. Preferably, data is collected from health provider sources and stored in a database on a server at a service provider site. The data is processed at the server, and is displayed in the patient's home using a TV connected to a multimedia processor. The multimedia processor connects the television set to a communications network such as the Internet. Applications include preventive care of chronic diseases such as diabetes and asthma.

42 Claims, 8 Drawing Sheets



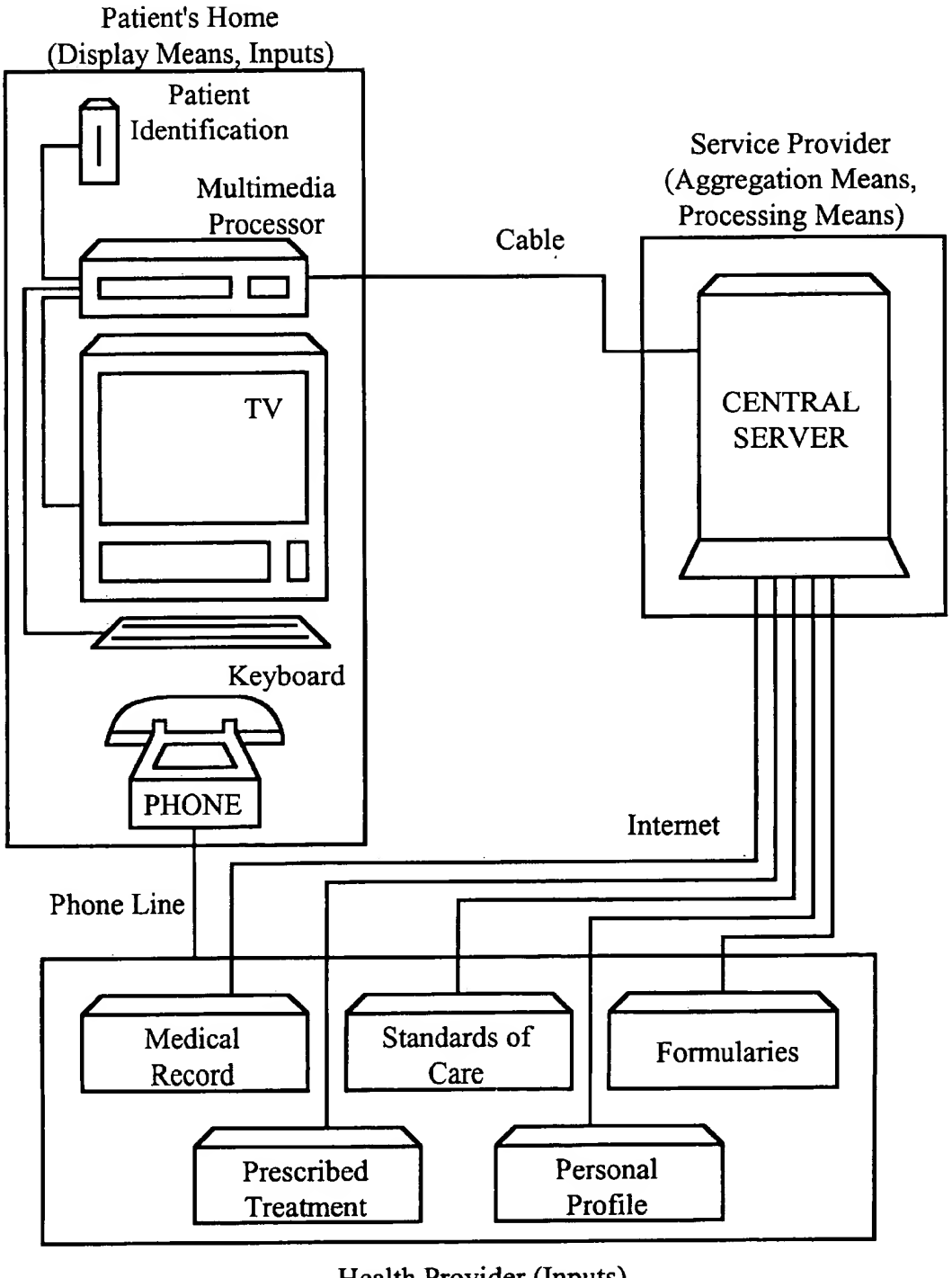

Patient's Home
(Display Means, Inputs)
Patient
Identification
Multimedia
Processor
TV
Keyboard
PHONE
Phone Line
Cable
Service Provider
(Aggregation Means,
Processing Means)
CENTRAL
SERVER
Internet
Medical
Record
Standards of
Care
Formularies
Prescribed
Treatment
Personal
Profile
Health Provider (Inputs)

FIG. 1

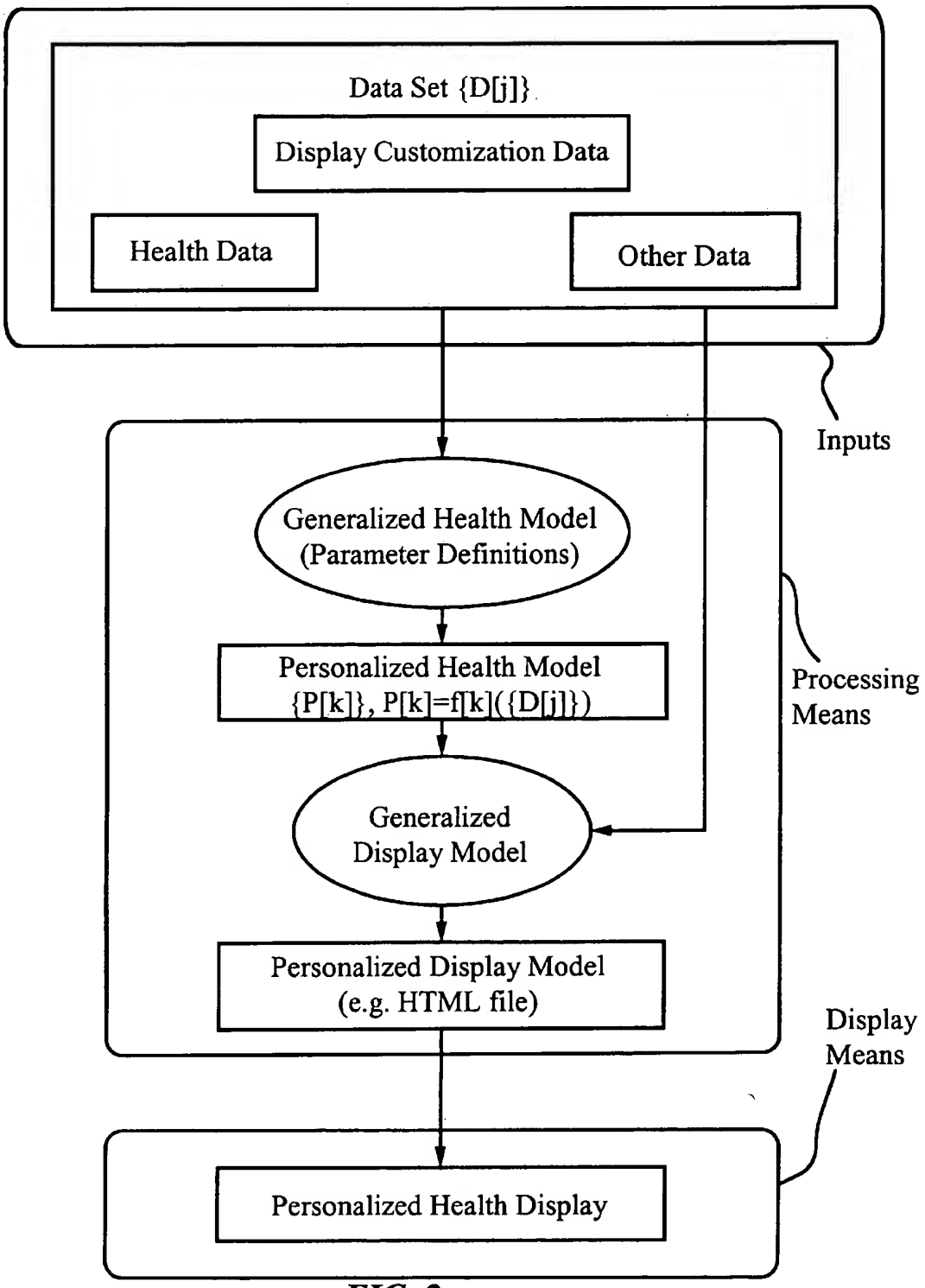

Data Set {D[j]}
Display Customization Data
Health Data
Other Data
Inputs
Generalized Health Model
(Parameter Definitions)
Personalized Health Model
{P[k]}, P[k]=f[k]({D[j]})
Generalized
Display Model
Personalized Display Model
(e.g. HTML file)
Processing
Means
Display
Means
Personalized Health Display

FIG. 2

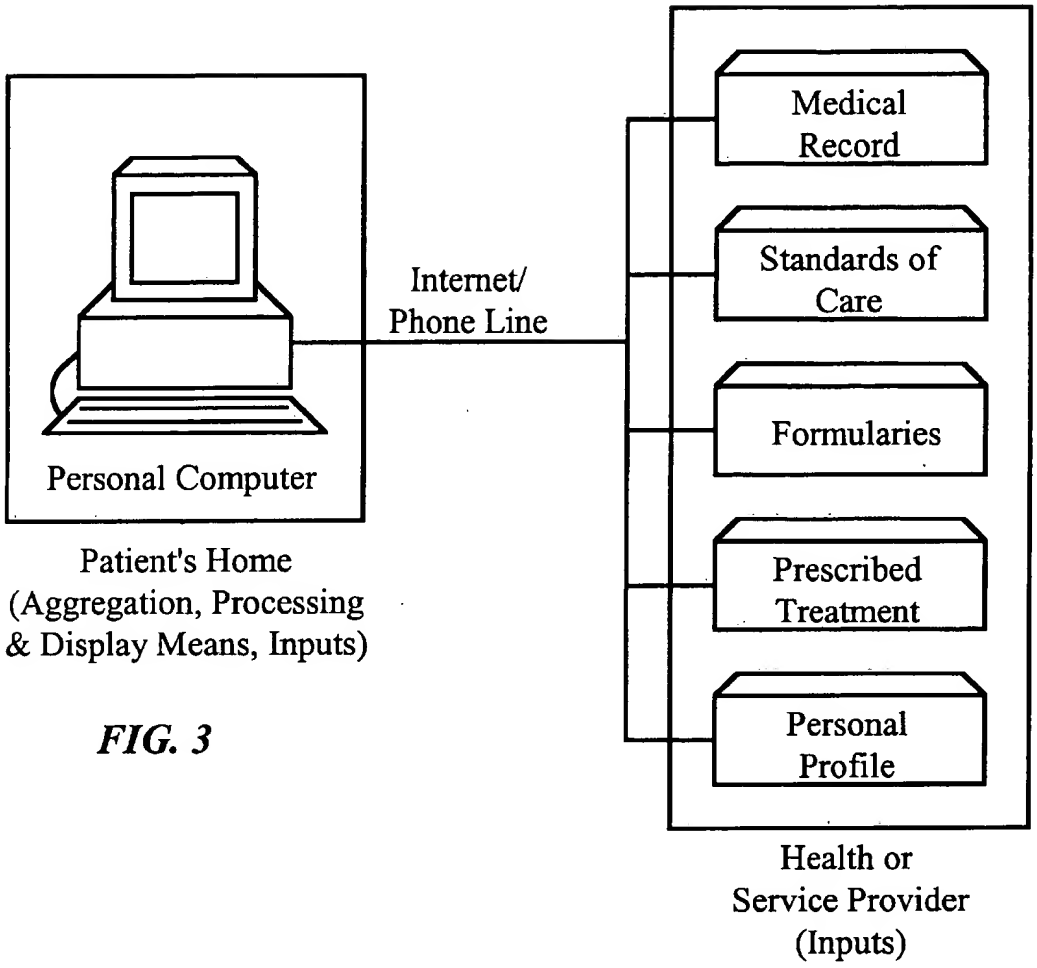

Medical Record
Standards of Care
Formularies
Prescribed Treatment
Personal Profile
Internet/ Phone Line
Personal Computer
Patient's Home (Aggregation, Processing & Display Means, Inputs)
Health or Service Provider (Inputs)

FIG. 3

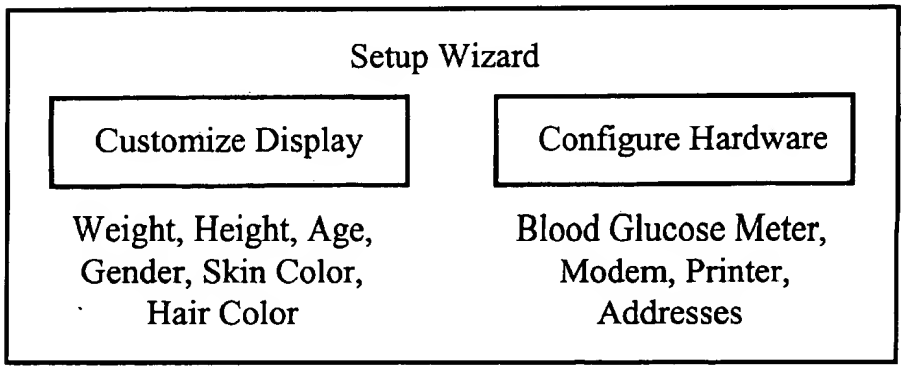

Setup Wizard
Customize Display
Configure Hardware
Weight, Height, Age, Gender, Skin Color, Hair Color
Blood Glucose Meter, Modem, Printer, Addresses

FIG. 4-A

FIG. 4-B

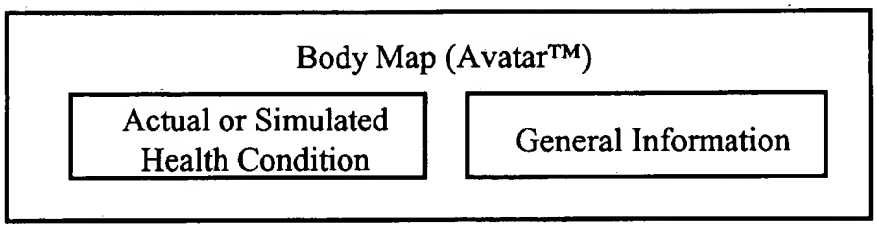


FIG. 4-C

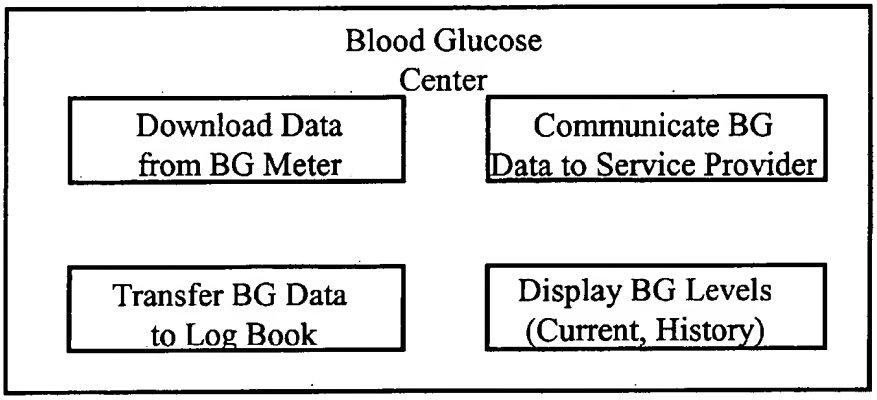


FIG. 4-D

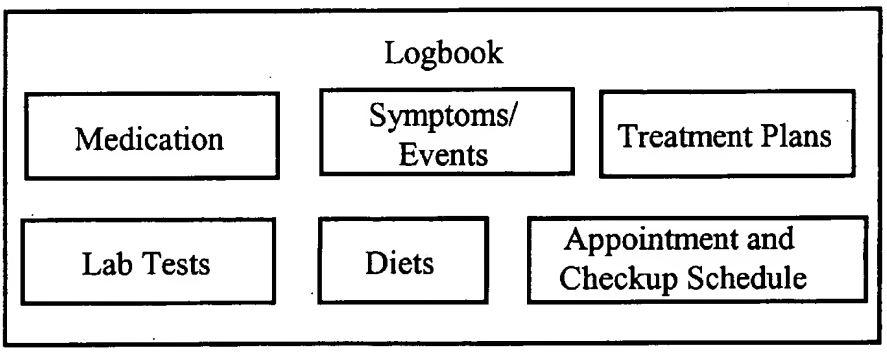
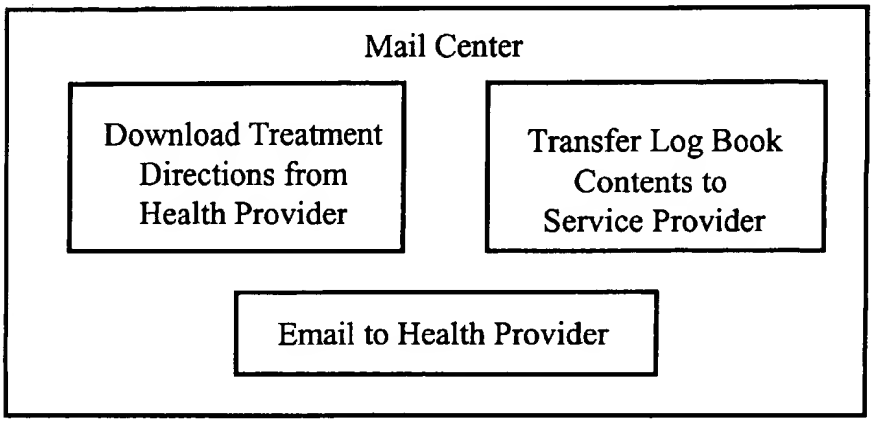


FIG. 4-E



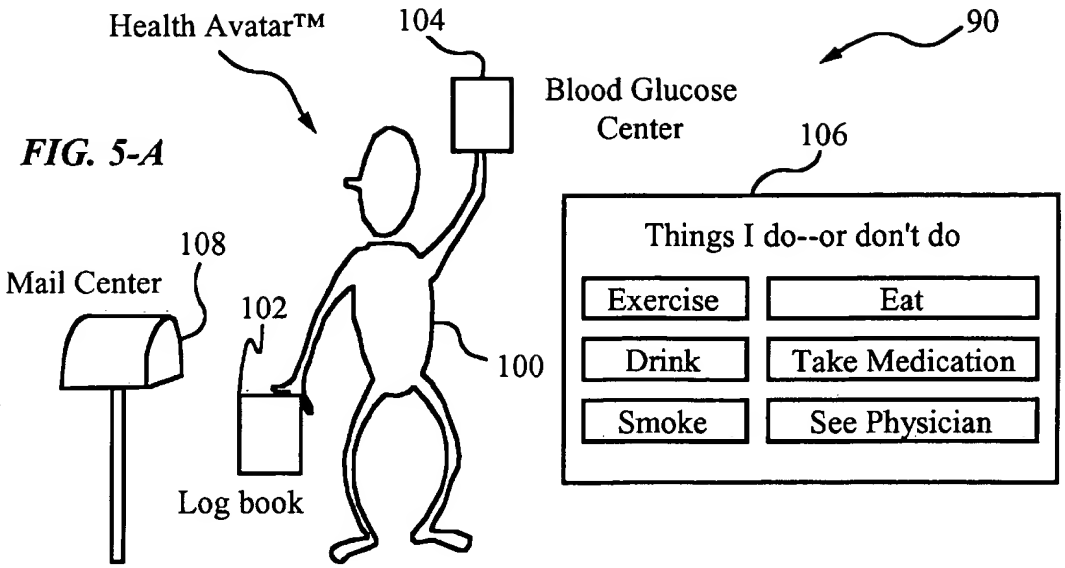

Health Avatar™
104
90
Blood Glucose Center
106
Things I do--or don't do
Exercise
Eat
Drink
Take Medication
Smoke
See Physician
108
Mail Center
102
100
Log book

FIG. 5-A

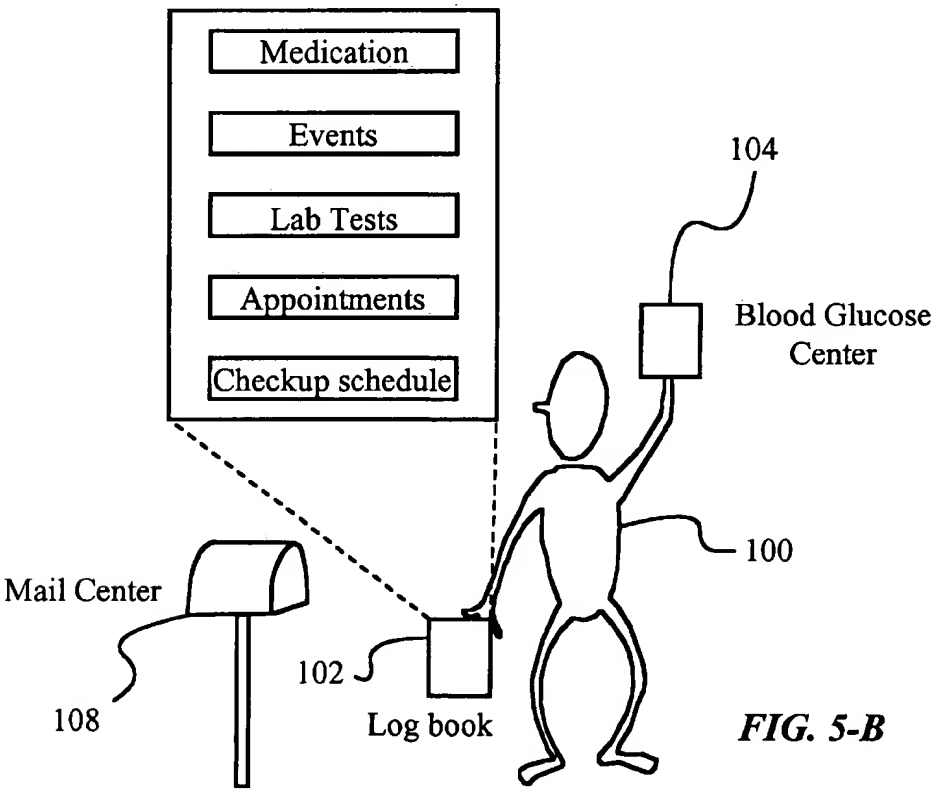
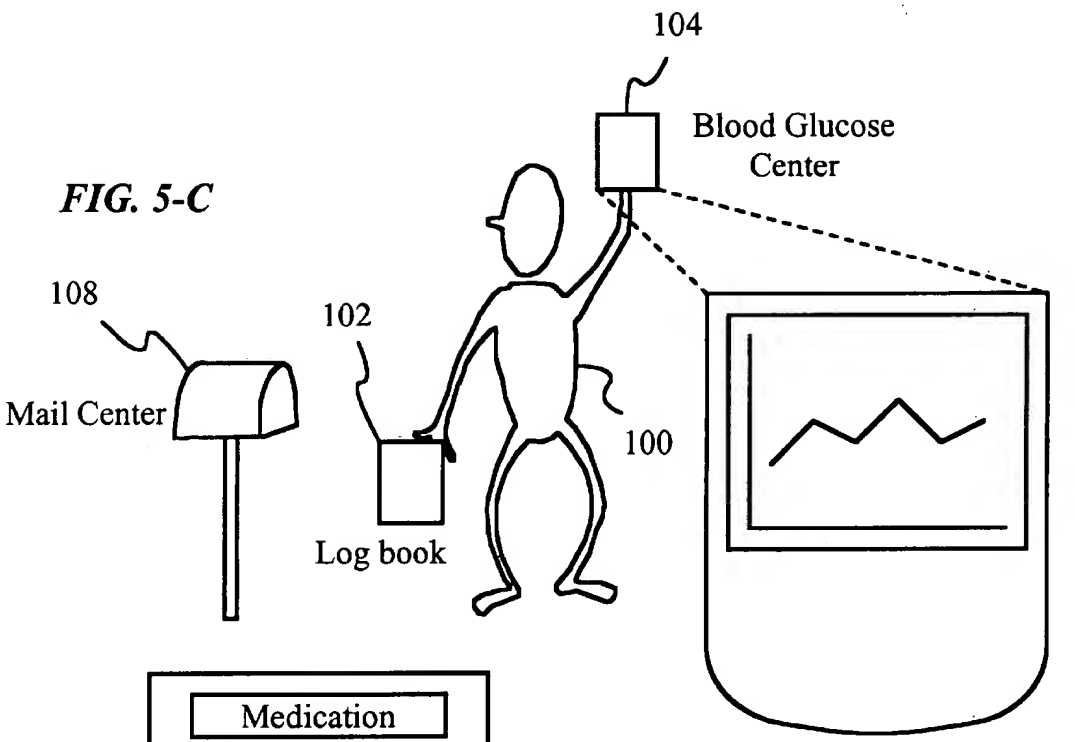

Medication
Events
Lab Tests
Appointments
Checkup schedule
104
Blood Glucose Center
100
Mail Center
102
108
Log book

FIG. 5-B

FIG. 5-C


104
Blood Glucose Center
108
Mail Center
102
Log book
100

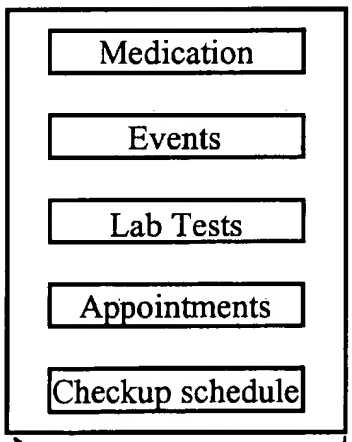

Medication
Events
Lab Tests
Appointments
Checkup schedule

FIG. 5-D

104
Blood Glucose Center
108
Mail Center
102
Log book
100
Your 3 Month Foot Exam is Due Please Make an Appointment

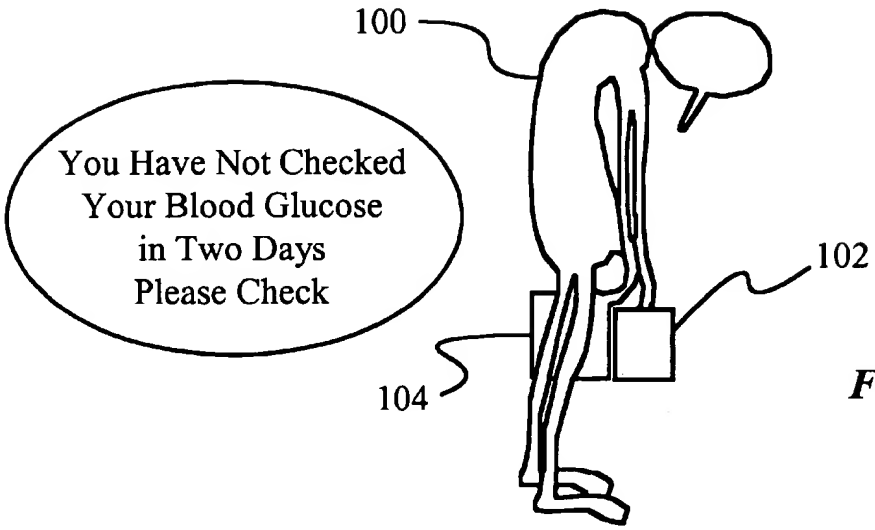

100
You Have Not Checked
Your Blood Glucose
in Two Days
Please Check
102
104

FIG. 5-E

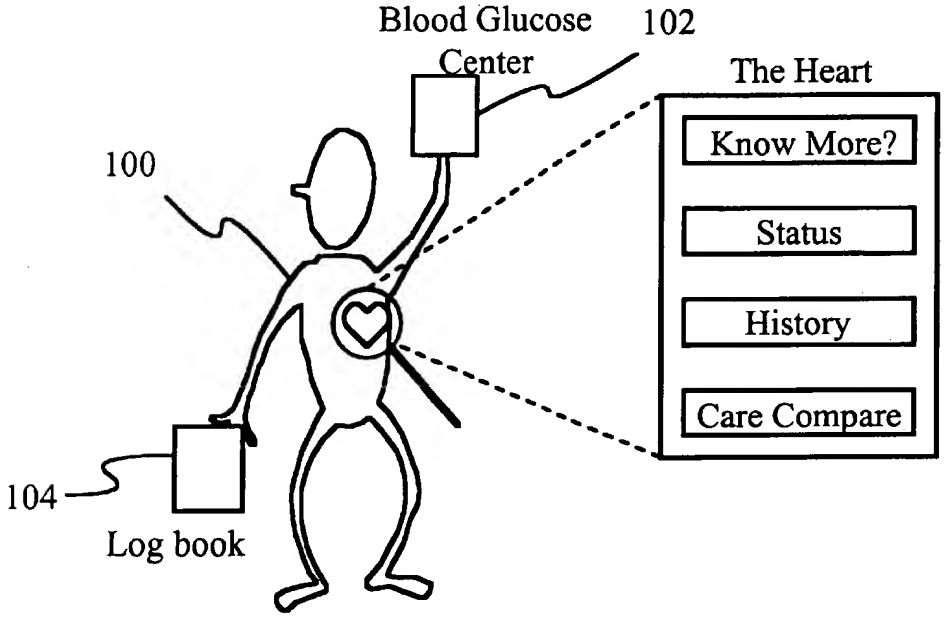

Blood Glucose
Center
102
The Heart
100
Know More?
Status
History
Care Compare
104
Log book

FIG. 5-F

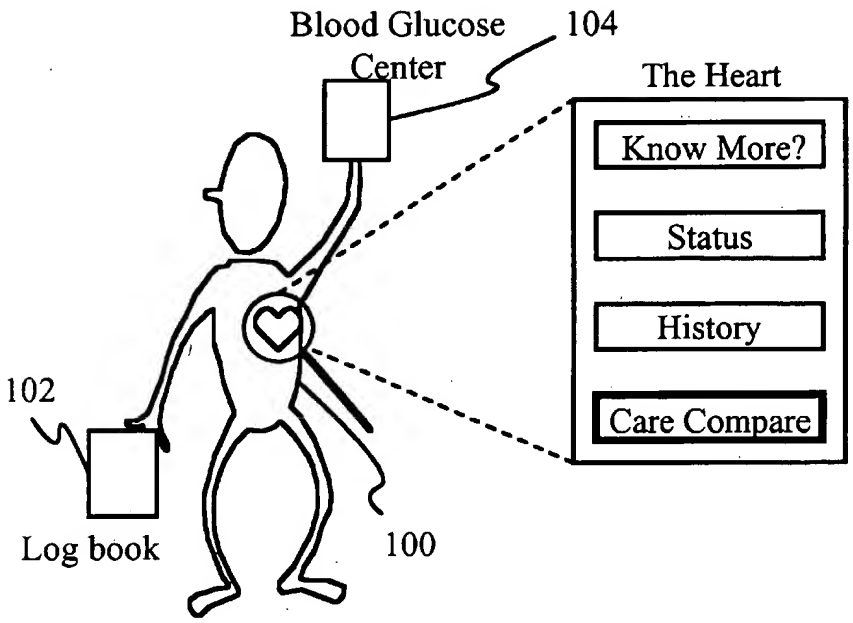


FIG. 5-G

You have searched the database for TESTS done in relation to DIABETES and HEART

1. Heart Exam
43% of people with Diabetes had no heart exam performed in one year.

57% of people with Diabetes had at least one heart exam performed in one year.

More Information?
Press Here for detailed info about the test, including the ADA's recommendations for tests in people with diabetes.

PERSONALIZED DISPLAY OF HEALTH INFORMATION

RELATED APPLICATION DATA

This application is related to co-pending U.S. patent application Ser. No. 08/732,158, entitled "Multiple Patient Monitoring System for Proactive Health Management," by inventor Stephen J. Brown, herein incorporated by reference.

FIELD OF THE INVENTION

This invention relates to computer systems for managing health care, and in particular to a system and method for displaying personalized health information to a patient having a chronic disease or health condition.

BACKGROUND OF THE INVENTION

The health care community has recognized in recent years the importance of preventive care in managing patients' health. Preventive care is particularly important in managing the health of patients having chronic diseases or long-term conditions. Preventive care includes educating patients about their disease, ensuring communication between patients and health care providers (e.g. doctors), and providing patients with tools and/or treatments for managing their disease.

Commonly used preventive care approaches suffer from several drawbacks. Much of health care is voluntary, and thus a large fraction of health care resources is typically spent on patients who are actively seek involvement in their care. A large number of patients do not actively seek information and treatment in the absence of symptoms, however. Also, health providers receive very little information on whether patients are complying with preventive care guidelines. Thus, health providers often are not able to take remedial steps before the disease affects the patients symptomatically (e.g. through pain). Reaching passive patients is thus critical to delivering effective preventive care.

The mass-marketing techniques used for health education by most health maintenance organizations (HMOs) and insurance companies allow little customization of information to an individual patient's needs. Consequently, many patients may not directly identify with the educational approaches used by their health providers. Personalizing health education would significantly raise the effectiveness of preventive care, especially in children and adolescents.

U.S. Pat. No. 5,549,117 to describes a system for communicating health information between health providers and patients having a chronic disease such as asthma. A patient unit displays health information, and communicates health information between the patient and a health provider. The display is relatively impersonal, however.

OBJECTS AND ADVANTAGES OF THE INVENTION

It is a primary object of the present invention to provide a personalized display of a health condition of a patient, such that the patient identifies with the display. It is another object of this invention to provide a method of motivating a patient to follow a prescribed treatment regimen. It is yet another object of this invention to provide a health data display that can be easily comprehended. It is still another object of this invention to provide a system and method for involving patients in their own care, for providing feedback to patients about their health condition, and for monitoring patients' progress in managing their health condition.

SUMMARY OF THE INVENTION

A system of the present invention comprises a set of inputs, a processing means in communication with the inputs, and a display means in communication with the processing means. The set of inputs generate a set of data {D[j]}, j=1 . . . J. A datum D[j] of the set of data {D[j]} characterizes a personal health condition of a patient. The processing means generates a personalized health model of the patient from a generalized health model of the patient and from the data set {D[j]}. The display means generates a display comprising a body image. The body image illustrates the personalized health model.

The personalized health model is a parameterized model of the health of the individual patient under treatment. The personalized health model is defined by a set of parameters {P[k]}, k=1 . . . K. The generalized health model is a model of the disease or condition under treatment. The generalized health model is defined by a set of functions {f[k]} that specify the dependence of {P[k]} on {D[j]}. That is, P[k]=f[k]({D[j]}) for all k. The processing means assigns values to the parameters {P[k]} using the data {D[j]}. Parameters suitable for characterizing various diseases include condition of a body part/organ, blood glucose level, respiratory flow, blood pressure, cholesterol level, patient weight, T-cell count, and frequency of health episodes.

The set of inputs comprises a medical record of the patient, as well as records of: a standard of care for the general health condition or disease of the patient, a prescribed treatment of the patient, a display preference, and a personal profile of the patient. The set of inputs further comprises a patient identification means (preferably a card) connected to the display means. The patient identification means specifies the identity of the patient corresponding to a particular display. The patient identification means also specifies a prescribed treatment of the patient and an address of the processing means, allowing a communication between the display means and the processing means. The set of inputs also comprises a patient feedback means (preferably a keyboard) in communication with the processing means, for allowing the patient to communicate a subset of feedback data to the processing means. The feedback means also allows the patient to enter a subset of simulation data characterizing a simulated personal health condition of the patient.

The display means preferably comprises a television set, and a multimedia processor for connecting the television set to the processing means. The display comprises a section assigned to a parameter P[k]. In particular, the body image comprises a section assigned to a parameter P[k]. A set of characteristics of the body image match a set of predetermined physical characteristics, such that the patient is able to customize the appearance of the body image. Such physical characteristics include age, height, gender, weight, skin color, and hair color. In a particular embodiment, the body image comprises a reproduction of an image of the patient (e.g. a photograph of the patient). In another embodiment, the body image comprises an image of a fictional character.

Preferably, the processing means is in communication with the display means over a remote network, such that the processing means is able to handle processing for multiple display means located at different patient locations. The processing means is in communication with at least some of the set of inputs over a remote network. Processing means at a service provider location can thus access inputs at a health care provider location. A data aggregation means

(preferably a database) is in communication with at least some of the inputs and with the processing means. The data aggregation means collects a subset of the data set {D[j]} from the set of inputs, allowing a reduction in the number of direct connections between the processing means and the inputs. The data aggregation means is in communication with the display means over a remote network, so that the data aggregation means stores data for multiple patients.

DESCRIPTION OF THE FIGURES

FIG. **1** shows the architecture of a system for health information delivery in a preferred embodiment of the present invention.

FIG. **2** illustrates processing steps performed on medical and other data to generate a personalized display of the present invention.

FIG. **3** shows an alternative architecture of a system of the present invention.

FIG. **4**-A depicts the functions of a setup wizard in an embodiment of the present invention.

FIG. **4**-B illustrates the functions of a body image module of the present invention.

FIG. **4**-C shows the functions of a blood glucose center module of the present invention.

FIG. **4**-D shows the functions of a logbook module of the present invention.

FIG. **4**-E shows the functions of a mail center module of the present invention.

FIG. **5**-A illustrates schematically an introductory screen shot for a diabetes treatment system of the present invention.

FIG. **5**-B illustrates the display resulting from the patient's accessing the log book section of the display of FIG. **5**-A.

FIG. **5**-C illustrates the display resulting from the patient's accessing a subsection of the blood glucose center section of the display of FIG. **5**-A.

FIG. **5**-D shows a warning resulting from the patient's failure to have a timely foot checkup, according to the system illustrated in FIG. **5**-A.

FIG. **5**-E shows a warning resulting from a patient's failure to check a blood glucose level according to the patient's treatment plan, according to the system illustrated in FIG. **5**-A.

FIG. **5**-F shows the display of the system illustrated in FIG. **5**-A following the patient's accessing of a display subsection corresponding to the heart.

FIG. **5**-G shows the display of the system illustrated in FIG. **5**-F following a patient request for comparative care information on the heart.

DETAILED DESCRIPTION

In the ensuing description, the notation (A[j]) is understood to refer to a set of A[j], for j taking some values between a minimum value 1 and a maximum value J. The notation A[j] is understood to refer to some (fixed) j.

FIG. **1** is a schematic diagram illustrating a preferred architecture for a system of the present invention. A processing means (preferably computer software) located on a central server is in communication over remote communication networks with a display means and a set of inputs. The central server processes information for multiple patients, and is thus capable of communicating with multiple display means and input locations. The central server comprises a data aggregation means, preferably a database, in communication with the set of inputs and with the processing means. The data aggregation means collects a subset of the data set {D[j]} from the inputs. Data collected by the data aggregation means is accessed by the processing means. The display means is located at the patient's home. Preferably, the central server is in communication with the health provider over the Internet, and with the patient's home over a cable television delivery line.

The display means preferably comprises a conventional television receiver, and a means for connecting the TV set to a communications network, as illustrated in FIG. **1**. Preferably, the TV set is connected to the Internet via a multimedia processor such as a WebTV™ Internet Terminal from WebTV Networks (distributed by Sony). The multimedia processor is in communication over a remote network (such as the Internet, a phone line, or cable used for delivery of cable television programming) with a server at a service provider location.

The multimedia processor connects the processing means on the central server to inputs located at the patient's home: a patient feedback means preferably comprising a keyboard, and a patient identification means preferably comprising a data-bearing card, or "smart card". The multimedia processor has a receiving slot for receiving the patient identification smart card. The patient identification card contains an encrypted patient code, a prescribed treatment for the patient, and a URL address of the processing means. The keyboard allows the patient to provide a subset of feedback data, including display preferences specifying a formatting of the display.

The set of inputs further comprises inputs located at a health care provider location, including records of: a medical history of the patient, a standard of care for a general health condition or disease of the patient, a prescribed treatment for the patient, and a personal profile of the patient. The above-incorporated U.S. patent application Ser. No. 08/732,158 entitled "Multiple Patient Monitoring System for Proactive Health Management" contains further information on data available to the health care provider.

Examples of data specified by the inputs include blood glucose level histories, generally acceptable blood glucose levels, dates of doctor examinations, generally recommended time periods between doctor examinations, ratings of the patient's interest for a cultural subject (e.g. sports, music), and display customization variables entered by the patient.

FIG. **2** illustrates generally the processing steps performed on the data {D[j]}. A personalized health model of the patient is generated from a generalized health model of the patient's health condition and the patient-specific data {D[j]}. The personalized health model characterizes the patient's current health condition. The personalized health model is defined by a set of parameters {P[k]}, k=1 . . . K. In a preferred embodiment designed for diabetes preventive care, suitable parameters include blood glucose level, conditions of body parts or organs (e.g. heart, feet), and compliance with treatment and/or monitoring protocols. Parameters suitable for the characterization of other diseases include respiratory flow in asthma, blood pressure in hypertension, cholesterol in cardiovascular disease, weight in eating disorders, T-cell or viral count in HIV, and frequency or timing of episodes in mental health disorders.

The generalized health model specifies the dependence of the values {P[k]} on the data {D[j]}. The dependence is determined by a set of functions {f[k]}, where P[k]=f[k]({D

[j]}) for all k. That is, the value P[k] of the kth parameter is specified in general by a function f[k]. The function f[k] has as its argument the set of data {D[j]}, i.e. f[k] depends on at least one datum D[j] The forms of the functions {f[k]} can be readily determined by the skilled artisan according to the disease under treatment.

For example, parameter P[1] may measure the latest recorded blood glucose level of the patient, and the datum D[1] may be the latest blood glucose level recorded in the patient's medical record. Then the function f[1]({D[j]})=D[1], and P[1]=D[1]. Parameter P[2] may measure the health condition of the patient's feet, which may be defined to depend on parameters such as blood glucose level (D[1]), the time between doctor checkups (D[2]), and some other parameter D[j]. Then P[2]=f[2]{D[j]}=f[2](D[1], D[2], D[j]), wherein the exact form of the function f[2] is specified by the generalized health model.

Using the set of parameters {P[k]} and a generalized display model of the patient, the processing means generates a personalized display model of the patient. The personalized display model preferably comprises an HTML file encoding a display comprising a body image. Generating displays using HTML is well known in the art, and will not be discussed here in detail. The formatting of the body image is preferably customized to the targeted patient, such that the patient identifies with the body image. A set of the characteristics of the body image matches a set of predetermined characteristics. In particular, body image characteristics preferably match physical characteristics chosen by the patient. Such characteristics include age, height, gender, weight and/or build, skin color, hair color, and identity (if any) of a fictional character. In one embodiment, the body image is a schematic figure representing the patient. In other embodiments, the body image is a reproduction (e.g. a photograph) of the patient's appearance, a representation of a cartoon or fictional character, or a representation of a character in a field of interest of the patient (e.g. a favorite basketball player or movie actor).

The body image illustrates the personalized health model of the patient. In particular., the body image comprises sections assigned to body parts/organs of the patient. The image sections graphically represent the health conditions of the corresponding patient parts. Particular characteristics (e.g. color, shape, blinking rate) of the image sections are determined by the set of values {P[k]}. In general, each section of the body is assigned to at least one parameter P[k]. The body image is preferably an image map, such that the patient can access information on a body part or organ by clicking on the corresponding section of the body image.

In an embodiment suitable for the treatment of a diabetes patient, an unacceptable value of a parameter measuring a health condition of the patient's feet leads to a display of swollen feet on the body. The body's feet blink if the time period since the last doctor checkup is longer than a predetermined threshold. In an embodiment suitable for dental hygiene education, the teeth in the body image are represented to be black if a value P[k] measuring a health condition of the patients' teeth is below a predetermined threshold. The appearance of the entire body is used to characterize the personal health condition of the patient. For example, for a patient having low blood glucose levels the corresponding body is displayed to be tired.

In an embodiment used for simulating the effects of hypothetical health decisions or events on the patient's health condition, the data set {D[j]} includes a subset of simulation data characterizing a simulated personal health condition of the patient. The displayed body then contains information on the simulated health condition of the patient. The simulation can be used by the patient to examine, among others, the effects of hypothetical changes in behavior (e.g. diet and sleep patterns) on the patient's health condition.

FIG. **3** shows schematically an alternative system for delivering personalized health information, according to the present invention. A personal computer at the patient's home comprises aggregation, processing and display means. The keyboard of the personal computer is an input. Other inputs are at a remote location, and are in communication with the computer over a remote network. An HTML page illustrating the patient's personalized health model is generated on the patient's computer by the processing means.

A particular user interface of a system of the present invention is illustrated in FIGS. **4** and **5**. FIGS. **4**-A through **4**-E illustrate the functions provided by Health Avatar™, a diabetes management application. FIGS. **5**-A through **5**-G are schematic depictions of screen shots from the same application, illustrating the functions of the application.

As shown in FIG. **4**-A, a setup wizard is used by the patient to customize the appearance of the body image, and to enter configuration information for hardware and software in communication with the application. Hardware includes a blood glucose meter, a modem, a printer, while software includes a communications applications for communicating with health care providers and service providers.

The body image itself (the Health Avatar™) displays actual or simulated health information of the patient, according to actual or simulated health data (see FIG. **4**-B). The patient can use a blood glucose center (FIG. **4**-C) to download information from a blood glucose meter, to transfer blood glucose data to the service provider database, to transfer blood glucose data to a logbook, and to display current blood glucose levels or a history of blood glucose levels. A log book (FIG. **4**-D) allows the patient to access and modify records of medication, symptoms/events, lab tests, treatment plans, diets, and appointment and checkup schedules. A mail center (FIG. **4**-E) is used by the patient to download treatment directions from the health provider, to transfer log book contents to the service provider and/or the health provider, and to communicate by-e-mail with the health provider.

FIG. **5**-A is a schematic depiction of a screen shot **90** of the Health Avatar™ application. The display comprises several sections: a body image section **100**, a log book section **102**, a blood glucose center section **104**, a feedback section **106**, and a mail center section **108**. The patient accesses functions of the application by clicking on corresponding display sections or subsections.

The functions of the log book module become accessible if the patient clicks on log book section **102**, as illustrated in FIG. **5**-B. A similar display (not shown) is generated if the patient clicks on blood glucose center section **104**. FIG. **5**-C illustrates the display after the patient accesses the "Display Blood Glucose Level" (see FIG. **4**-C) subfunction of the blood glucose center. Feedback section **106** (FIG. **5**A) enables the patient to record information about his or her health habits.

Body image **100** comprises subsections corresponding to the patient's organs and/or body parts. If a particular body part of the patient requires attention or care, the corresponding subsection of body image **100** is highlighted. FIG. **5**-D depicts the application display if the diabetes patient neglects care of his or her feet. A display subsection corre-

sponding to the patient's feet blinks, and the patient is prompted to make an appointment with a care provider.

The overall appearance of body image section **100** depends on the blood glucose level of the patient, and on the time since the last recording of the patient's blood glucose level. FIG. **5**-E illustrates the application display if the patient fails to record or download his or her blood glucose levels according to a treatment plan.

FIG. **5**-F schematically depicts the application display if the patient clicks on a subsection of body image **100** corresponding to the patient's heart. The patient can request general information about the heart in diabetes patients, about the current and historical conditions of his or her heart, and about other patients approaches to the hearts' care.

FIG. **5**F schematically depicts a display following a patient's request, from the display depicted in FIG. **5**E, for general information about other patient's approaches to care of the heart.

It will be clear to one skilled in the art that the above embodiment may be altered in many ways without departing from the scope of the invention. For example, many relative placements of the aggregation, processing, and display means may be suitable in a system of the present invention. In particular, the data aggregation means may be in communication with the processing means over a remote network. Suitable parameters, data sets, and processing functions can be readily determined by the skilled artisan for various applications. Systems and methods of the present invention are suitable for the management of any chronic disease or condition requiring regular medical attention and patient compliance with a treatment plan, including diabetes, asthma, AIDS, heart and cardiovascular disease, weight control programs, mental health conditions, attention deficit disorder, smoking, and substance abuse. Many display and patient input implementations, including non-HTML-based implementations, can be suitable for use with the present invention. Accordingly, the scope of the invention should be determined by the following claims and their legal equivalents.

What is claimed is:

1. A system for displaying health information, comprising:

a) a set of inputs for generating a set of data {D[j]},j=1 . . . J, wherein a datum D[j] of said set of data {D[j]} characterizes a personal health condition of a patient and, wherein said set of inputs comprises a patient feedback means and a patients feedback generates a subset of said set of data;

b) a processing means in communication with said set of inputs, said processing means for generating a personalized health model of said patient from a generalized health model of said patient and from said set of data {D[j]}; and

c) a display means in communication with said processing means, for generating a display comprising a body image, said body image illustrating said personalized health model, said body image comprising an image map including at least one body part or organ, wherein said patient can access information on said at least one body part or organ by interacting with a section of said body image on said display means.

2. The system of claim **1**, wherein said personalized health model comprises a set of parameters {P[k]}, k=1 . . . K, and wherein said generalized health model specifies a dependence of said set of parameters {P[k]} on said set of data {D[j]}.

3. The system of claim **2**, wherein said processing means is adapted to assign values to said set of parameters {P[k]} using said set of data {D[j]}.

4. The system of claim **2**, wherein said set of parameters {P[k]} comprises a blood glucose level of said patient.

5. The system of claim **2**, wherein said set of parameters {P[k]} comprises a condition of a body part of said patient.

6. The system of claim **2**, wherein said set of parameters {P[k]} comprises a parameter selected from the group consisting of respiratory flow, blood pressure, blood glucose level, cholesterol level, patient weight, T-cell count, and frequency of health episodes.

7. The system of claim **1**, wherein said set of inputs comprises a patient identification means for specifying an identity of said patient, and wherein said patient identification means is in communication with said display means.

8. The system of claim **7**, wherein said patient identification means is adapted to specify a prescribed treatment of said patient.

9. The system of claim **7**, wherein said patient identification means comprises a card.

10. The system of claim **7**, wherein said patient identification means is in communication with said display means, and said patient identification means is adapted to specify an address of said processing means for allowing communication between said display means and said processing means.

11. The system of claim **1**, wherein said display means comprises a television set, and a multimedia processor for connecting said television set to said processing means.

12. The system of claim **1**, wherein said set of data {D[j]} comprises a subset of simulation data characterizing a simulated personal health condition of said patient.

13. The system of claim **1**, wherein said display and said body image each comprise a section assigned to a parameter P[k].

14. The system of claim **1**, wherein a set of characteristics of said body image match a set of predetermined physical characteristics of said patient.

15. The system of claim **14**, wherein said set of physical characteristics comprises a characteristic selected from an age, a height, a gender, a weight, a skin color, and a hair color.

16. The system of claim **1**, wherein said body image comprises a reproduction of a photograph of said patient.

17. The system of claim **1**, wherein said body image comprises an image of a sports personality or an image of a movie actor.

18. The system of claim **1**, wherein said processing means is in communication with said display means and with said set of inputs over at least one remote network.

19. The system of claim **1**, further comprising a data aggregation means in communication with said set of inputs and with said processing means, said data aggregation means for collecting a subset of said set of data {D[j]} from said set of inputs, wherein said data aggregation means is in communication with said display means over a remote network.

20. The system of claim **1**, further comprising at least one additional display means, wherein said at least one additional display means is in communication with said processing means over a remote network.

21. The system of claim **1**, wherein said processing means is located at a location remote from said display means.

22. The system of claim **1**, further comprising a central server located at a location remote from said display means, wherein said central server includes said processing means and an aggregation means, and said central server is in communication with said display means over a remote network.

23. The system of claim 22, wherein said display means is located at a home of said patient.

24. The system of claim 23, wherein said display means comprises a conventional television receiver.

25. The system of claim 21, wherein said display means further comprises a multimedia processor including an Internet terminal, said multimedia processor is connected to said conventional television receiver, and said central server is in communication with a health provider over the Internet.

26. The system of claim 22, wherein said central server is in communication with said display means over a cable television delivery line.

27. The system of claim 1, wherein said patient is a diabetes patient, and wherein the condition of said at least one body part or organ is impacted by diabetes.

28. The system of claim 27, wherein said at least one body part or organ is the heart or a foot.

29. The system of claim 1, wherein said set of inputs comprises a record selected from the group consisting of a medical record of said patient, a record of a standard of care for a general health condition of said patient, a record of a prescribed treatment of said patient, a record of a display preference, and a record of a personal profile of said patient.

30. The system of claim 1, wherein said body image is a personalized body image representing the patient, said display means displaying said personalized body image for viewing of said personalized body image by the patient, wherein the patient identifies with said personalized body image.

31. The system of claim 1, wherein said display further comprises a health care parameter section, a logbook section, a feedback section, and a mail center section.

32. The system of claim 31, wherein said logbook section is adapted for use by said patient to access and modify records of: medication, symptoms/events, lab tests, treatment plans, diet, and appointment and checkup schedules; wherein said mail center section is adapted for use by the patient to download treatment directions from a health provider, to transfer logbook contents to the service provider and/or to the health provider, and to communicate by e-mail with the health provider; and wherein said feedback section is adapted for use by the patient to record information about his or her health habits.

33. The system of claim 31, wherein said health care parameter section comprises a blood glucose center section, said blood glucose center section adapted for use by said patient to: download information from a blood glucose meter, transfer blood glucose data to a service provider database, transfer blood glucose data to a logbook, display current blood glucose level, and to display a history of blood glucose levels.

34. A method of providing personalized health information to a patient, said method comprising the steps of:

a) generating a set of data {D[j]}, j=1 . . . J, from a set of inputs, wherein a datum D[j] of the set of data {D[j]} characterizes a personal health condition of a patient;

b) generating a personalized health model of the patient, wherein the personalized health model is generated by a processing means from a generalized health model of the patient and from the set of data {D[j]};

c) generating a display on a display means, wherein the display is generated by the processing means, and wherein the display comprises a body image, the body image illustrating the personalized health model of the patient; and

d) having the patient view the body image on the display means, wherein the patient relates personally to the personalized health model illustrated by the body image and, wherein said the body image comprises an image map such that the patient can access information on at least one body part or organ of the body image by interacting with a section of the body image on the display means.

35. The method of claim 34, wherein the processing means comprises software located at a central server remote from the display means.

36. The method of claim 34, wherein the display means comprises a television set coupled to a multimedia processor.

37. The method of claim 34, wherein the set of inputs are entered via a keyboard of a personal computer or via a smart card.

38. The method of claim 34, wherein the display further comprises a health care parameter section, a logbook section, a feedback section, and a mail center section.

39. The method of claim 38, further comprising the step of:

c) accessing data, by the patient, from the health care parameter section, the logbook section, or the mail center section.

40. The method of claim 38, further comprising the step of:

d) inputting data, by the patient, via the health care parameter section, the logbook section, the feedback section, or the mail center section.

41. A system for displaying a personalized health model of a patient to the patient, comprising:

a) a set of inputs for generating a set of data {D[j]}, j=1 . . . J, wherein a datum D[j] of said set of data {D[j]} characterizes a personal health condition of a patient, wherein said set of inputs comprises a first set of inputs and a second set of inputs, said first set of inputs located at a home of the patient, and said first set of inputs comprising a patient identification means and a patient feedback means, and wherein said second set of inputs are located at a health care provider remote from a home of the patient, and said second set of inputs selected from the group consisting of a medical record of said patient, a record of a standard of care for a general health condition of said patient, a record of a prescribed treatment of said patient, a record of a display preference, and a record of a personal profile of said patient;

b) a central server including a processing means in communication with said set of inputs, said processing means for generating a personalized health model of a patient from a generalized health model of the patient and from said set of data {D[j]}; and

c) a plurality of display means, each of said plurality of display means located at a location remote from said processing means and in communication with said processing means over a remote network, each of said plurality of display means for generating a display comprising a body image illustrating said personalized health model of a patient, wherein said body image comprises an image map.

42. The system of claim 41, wherein said processing means generates a personalized display model comprising a personalized body image of the patient for displaying on said display means, wherein said personalized body image includes a set of characteristics which match physical characteristics chosen by the patient, said personalized body image is personalized for viewing by the patient and the patient identifies personally with said personalized body image.

* * * * *

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United States Patent [19]

Korenman et al.

[11] Patent Number: 6,067,468

[45] Date of Patent: *May 23, 2000

[54] **APPARATUS FOR MONITORING A PERSON'S PSYCHO-PHYSIOLOGICAL CONDITION**

[75] Inventors: **Ernesto Marcelo Dario Korenman**, Wembley; **Tuvi Orbach**, London; **Bernard William Watson**, Harpenden, all of United Kingdom

[73] Assignee: **Ultramind International Limited**, Tel Hashomer, Israel

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **08/754,102**

[22] Filed: **Nov. 20, 1996**

Related U.S. Application Data

[63] Continuation of application No. 08/190,163, filed as application No. PCT/GB92/01477, Aug. 7, 1992, abandoned.

[30] **Foreign Application Priority Data**

Aug. 7, 1991 [GB] United Kingdom 9117015

[51] **Int. Cl.**[7] **G06F 1/00**

[52] **U.S. Cl.** **600/547**

[58] **Field of Search** 600/21, 26, 27, 600/28, 300, 481, 482, 483, 484, 485, 500, 527, 528, 533, 547

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Primary Examiner—Robert L. Nasser
Attorney, Agent, or Firm—Breiner & Breiner

[57] **ABSTRACT**

The running of a program, designed to train the user to control one or more aspects of his or her psycho-physiological state, is controlled by signals representative of a psycho-physiological parameter of the user, e.g., galvanic skin resistance. This may be detected by a sensor unit with two contacts on adjacent fingers of a user. The sensor unit is separate from a receiver unit which is connected to a computer running the program.

7 Claims, 5 Drawing Sheets

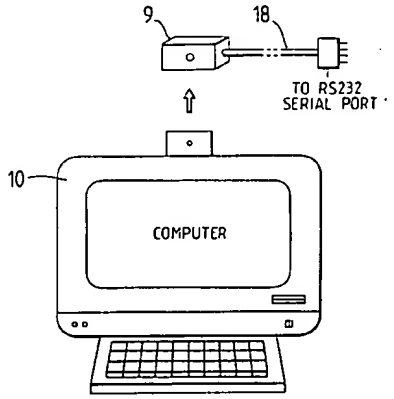

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FIG. 1.

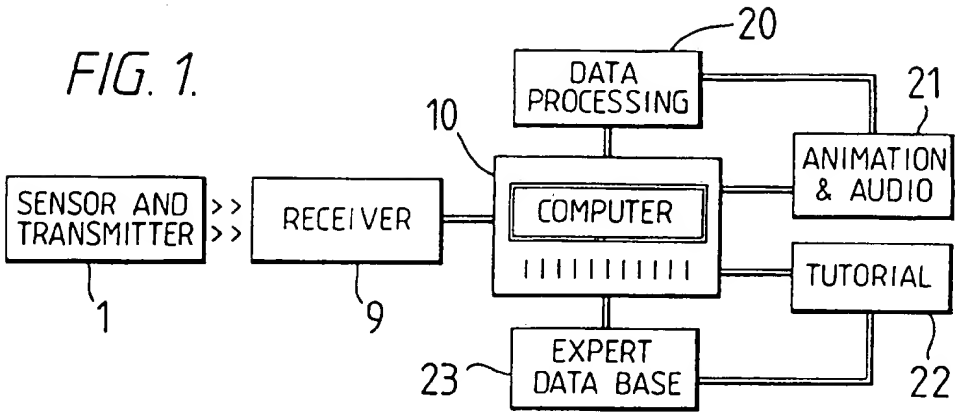


FIG. 2a

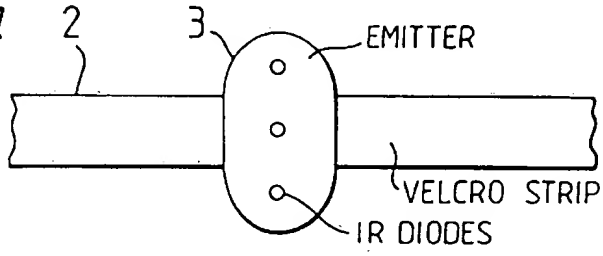


FIG. 2b

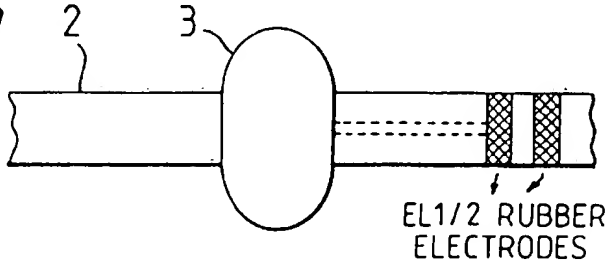


FIG. 2c

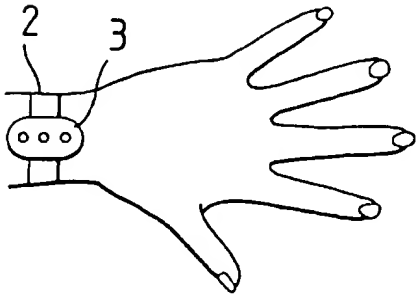


FIG. 2d

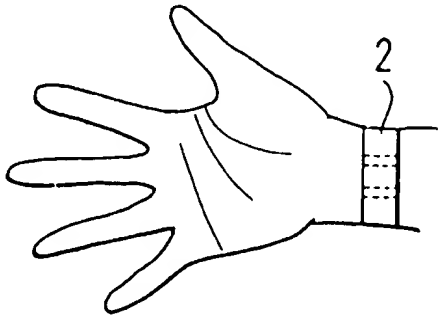


FIG. 3.

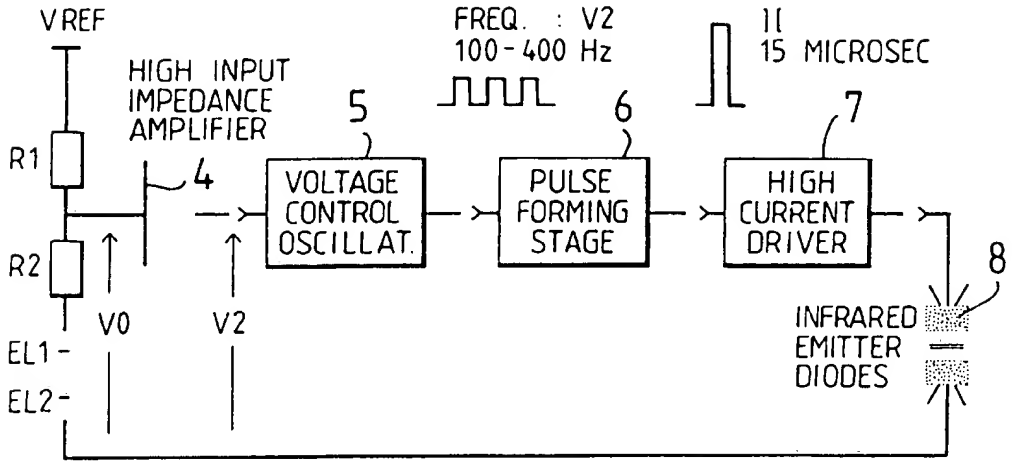

VREF
HIGH INPUT IMPEDANCE AMPLIFIER
FREQ. : V2
100 - 400 Hz
15 MICROSEC
R1
R2
4
5
6
7
8
VOLTAGE CONTROL OSCILLAT.
PULSE FORMING STAGE
HIGH CURRENT DRIVER
INFRARED EMITTER DIODES
V0
V2
EL1 -
EL2 -

FIG. 4.

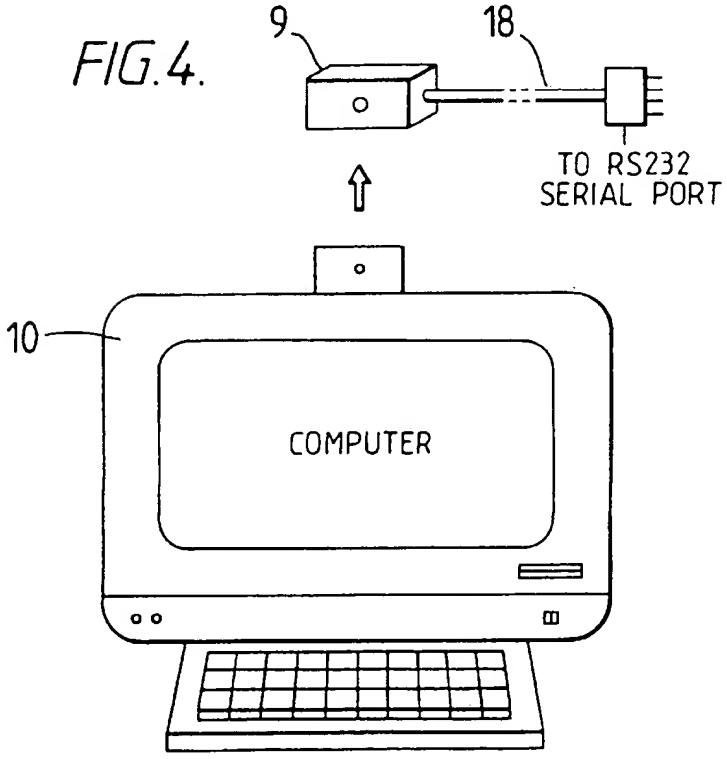

9
18
TO RS232 SERIAL PORT
10
COMPUTER

FIG. 5.

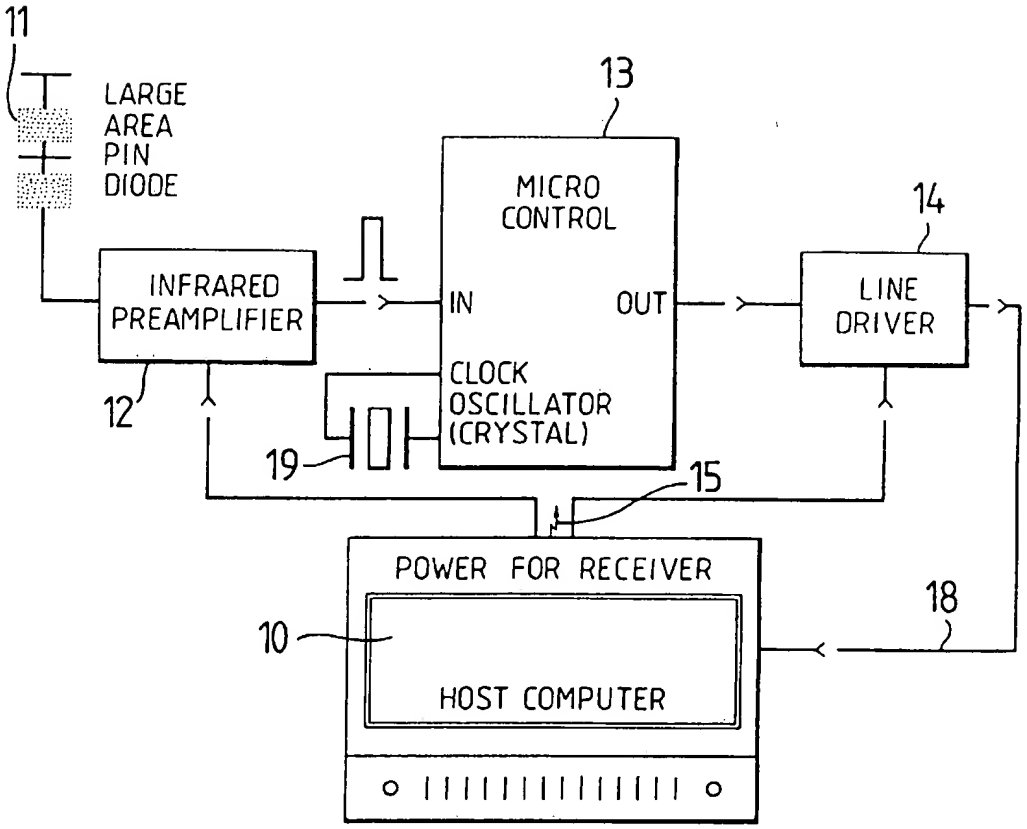

11
LARGE
AREA
PIN
DIODE
13
MICRO
CONTROL
IN
OUT
14
LINE
DRIVER
INFRARED
PREAMPLIFIER
12
CLOCK
OSCILLATOR
(CRYSTAL)
19
15
POWER FOR RECEIVER
10
HOST COMPUTER
18

FIG. 6.

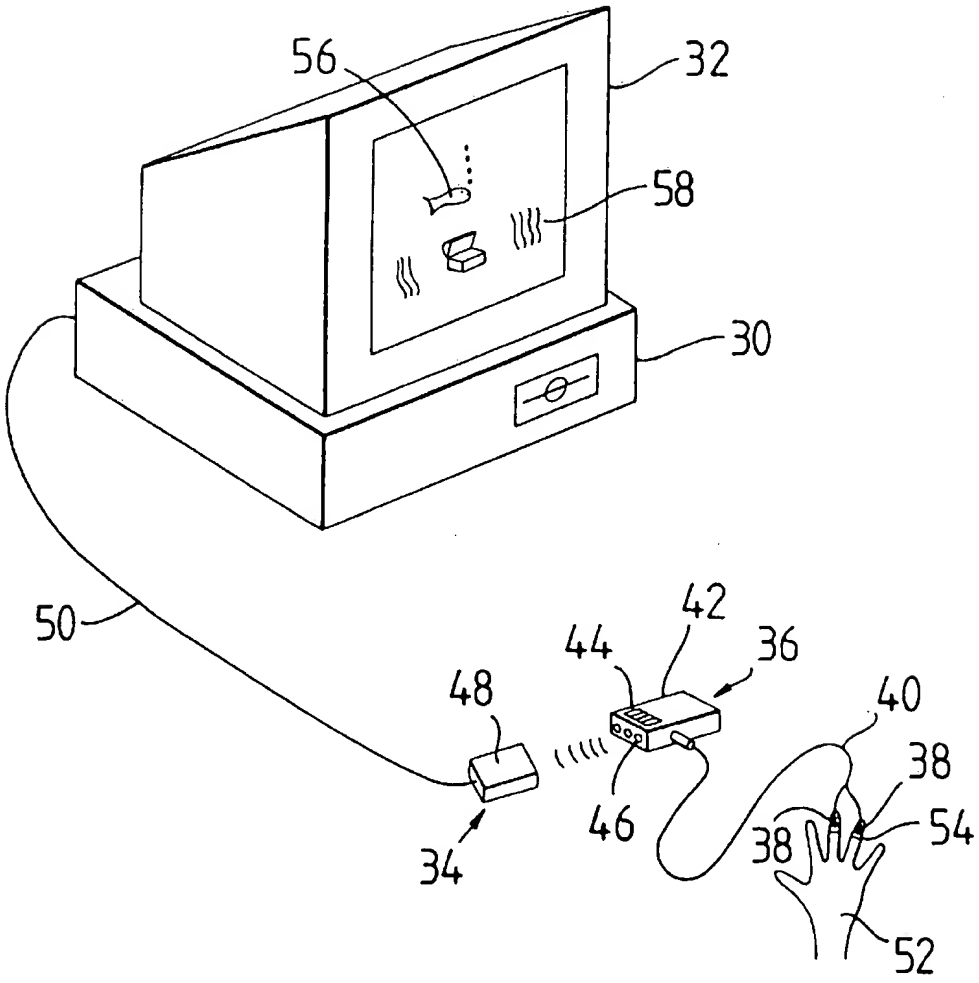
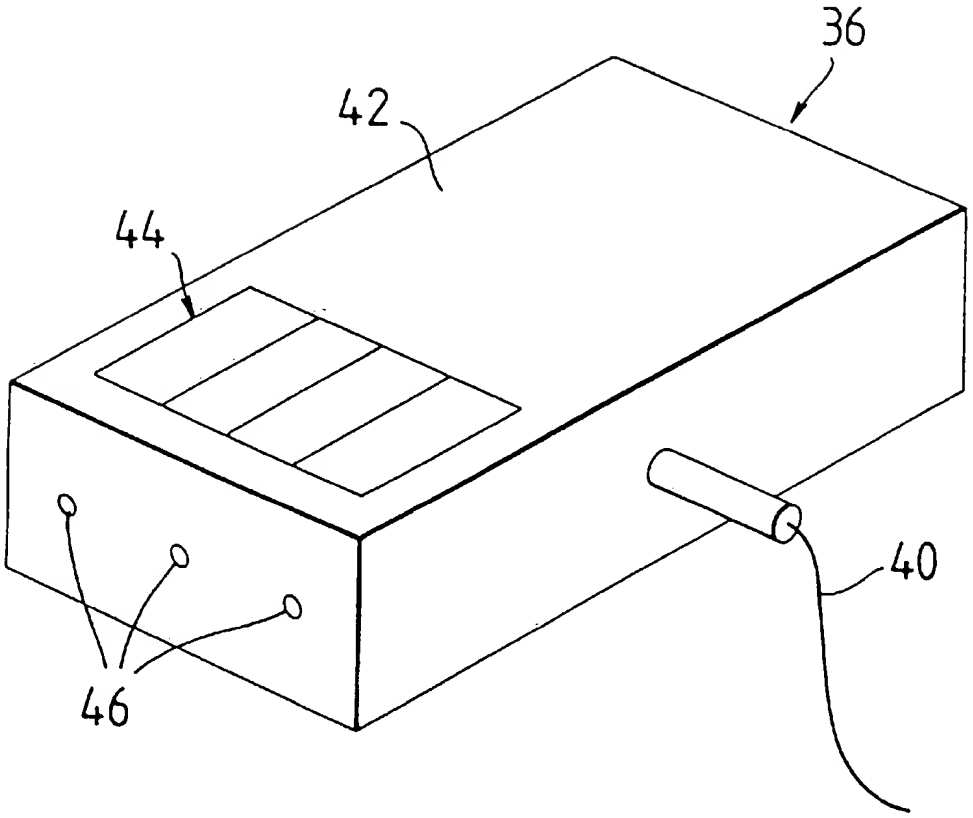


FIG. 7.



APPARATUS FOR MONITORING A PERSON'S PSYCHO-PHYSIOLOGICAL CONDITION

This is a continuation of application Ser. No. 08/190,163 filed on Feb. 7, 1994, now abandoned, which was filed as PCT/GB92/01477 on Aug. 7, 1992.

FIELD OF INVENTION

This invention relates to the operation of computer systems, particularly, though not exclusively, to computer-assisted learning.

BACKGROUND OF INVENTION

In recent years, the development of so-called "personal computers", or PCs for short, has enabled computing power to be made available to millions of people. In parallel with the development of the hardware, there has been major growth in the amount of software being written. In a PC system, the user operates the PC by first controlling it with the aid of software to be ready to operate in accordance with a desired programme, and then inputting data and producing output data from the PC.

In order to input data, a variety of devices may be used, the most common of which is a keyboard. The most common output device is a visual display unit (VDU) or screen on which the results of operations within the computer may be displayed to be read (if expressed in words) and/or viewed by the user.

Other input may be fed into the computer in known fashion. For example, most PCs have one or more communications ports which can send or receive data in the form of digital signals. The data can be received, e.g. from sensor units via appropriate interface circuits, or from other PCs. It is known that a very wide variety of sensors may be used, including sensors which sense human physiological parameters, for example blood pressure or electrical currents in the body (in computer-controlled electrocardiogram or electroencephalogram systems). However, up till now, such uses have been mainly confined to those where the computer user has not been the same person as the person under test.

An example where such use is not confined to those where the computer user has not been the same person is shown in published International Application WO 86/01317 which discloses using galvanic skin resistance to input data into a computer, and deals specifically with the electronics necessary to overcome the problem of the very wide range of galvanic skin resistances that may be sensed over a period of time and from one user to another.

Published International Application WO89/02247 discloses a system whereby a PC owner may monitor his or her heart activity using a simple probe which connects to the input of the computer. A suitable programme must be loaded into the computer in order to enable display or printout representative of the user's cardiac function to be effected. Published European Patent Application 0176220 also discloses using a computer to monitor a user's heart.

Published International Application WO 91/01699 discloses use of a computer and suitable sensor means to offer limited mobility and limb movement patients are means of operating a computer. United States Patent Specification 4894777 uses sensor means to detect when a computer user ceases to concentrate on the subject they should be concentrating on, and published UK Patent Specification 2079992A discloses using a sensor means and microcomputer to predict the fertility period in a woman's menstrual cycle.

GENERAL DESCRIPTION OF THE INVENTION

In accordance with the present invention, there is provided apparatus for testing an aspect of one or more users psycho-physiological condition which provides an information display which may be viewed by the user and which at least provides information about, or indication of, the user's substantially current psycho-physiological condition reflected by that aspect being tested, and which may provide one or more stimuli to the user, the apparatus comprising a computer system, an input device, and software capable of interpreting data input from the input device and displaying the required information, wherein the input device comprises a sensor unit and a receiver unit;

the sensor unit is adapted to be attached to one or more users and periodically to sense at least one psycho-physiological condition and to transmit data corresponding to the user's psycho-physiological condition to the receiver unit;

the receiver unit being adapted to input the data concerning the user's condition into the computer system;

the sensor unit and the receiver unit being separate from each other.

Such apparatus, providing the programme or software is appropriate, may also be used to enable control of a computer game by way of the user's control of one or more of his or her psycho-physiological parameters. Thus, the precise running of programme may depend on both conscious input from the user and on one or more psycho-physiological parameters of the user.

In using the apparatus, the user interacts with the programmed computer via two channels, the conscious voluntary channel, e.g. mediated via a standard keyboard or via keys on a keypad forming part of the sensor unit and an unconscious involuntary channel, e.g. mediated via a galvanic skin resistance (GSR) sensor and appropriate circuitry to feed a signal representative of GSR to the receiver and thence the computer system. It is known that GSR correlates with arousal/relaxation. Thus, the operation of an interactive learning programme or of a games programme may be mediated not merely by the user's keyboard input but by his or her state of arousal. For example, the speed at which a game is to be played may vary depending on GSR, giving relaxed players an advantage over tense ones. The 'game' may be of a type designed to teach definite behavioural skills. As in other computer games, performance during the game is monitored and quantified, and the dexterity shown in the different tasks is measured, for example, the game may test for and train fast recovery after psychomotor challenge. The user may be made to perform a pre-defined psychomotor, such as time response or co-ordination tasks and should then return immediately to the same state of arousal prior to the challenge. Whether he or she returns to an increased or decreased level of arousal may be reflected by animation refinements, e.g. the shape and configuration of a display icon. Alternatively, such a programme may teach the user to reach a predetermined level of arousal and remain within a range around that level for a certain period of time, and to detach himself or herself from external stimuli such as computer sound, mind information, etc., remaining at a certain level of arousal.

In order to put the invention into effect, it is necessary to have computer apparatus arranged to provide a visual output under control of a programme, the output being dependent on input via the keyboard and input via a psycho-physiological parameter sensor located to monitor such a parameter of the user. In a preferred form, the sensor unit

communicates with the receiver unit connected to the computer input via a non-physical connection, such as an electromagnetic cordless link, thus enabling the user to 'forget' that he or she is interacting with the computer. An infrared transmitter-receiver system is the preferred non-physical connection. Such systems are inexpensive and reliable, and, on account of their use in remote controllers for electrical or electronic apparatus (garage doors, video recorders, CD players), are widely available.

The range of application of the present invention is very wide. One particular valuable field is in computer-assisted learning, where the 'teaching' computer may be able to modify its part in an interactive programme in accordance with the condition of the user. Thus, like a human teacher, the computer may go slower if it senses that its pupil is tired, or showing signs of stress related to incomprehension, or may even judge the user's state as non-receptive and refuse to teach him or her further until the appropriate input is received, showing that the user is receptive to teaching again.

The programme may be arranged to display to the user an indication of the psycho-physiological parameter measured, thus enabling the user who so wishes to try and consciously moderate or modify their response in a fashion analogous to 'biofeedback' techniques. For example, a teaching programme could be arranged to display as a variable height bar or variable colour spot the arousal state of the user, determined from GSR and/or other measurements.

In principle, the display viewed by the user may vary very widely and consist of graphics, animation, wording or combinations of these. The timing of image display will be controlled by the programme. The programme may be one which displays subliminal stimuli via the screen as well as consciously perceptible images.

The conscious interaction between computer system and user may also be mediated via one or more standard usually manually controlled devices, e.g. keyboard, mouse, joystick. The unconscious interaction via sensor and receiver may rely on one or more parameters, for example GSR, brain or cardiac electrical signals (as in EEG and ECG monitoring), heart or pulse rate, skin temperature, or others. In all such cases, it is highly desirable that the parameter is sensed and data fed to the computer as a result in an unnoticeable way, so leaving the unconscious input to the computer easily forgotten about so that it does not distract the user from concentrating on interacting with the computer consciously.

BRIEF DESCRIPTION OF DRAWINGS

Embodiment of apparatus in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. **1** is a block diagram of apparatus for use in interactive training mediated by psycho-physiological performance;

FIGS. **2***a* and **2***b* show front and back views of a sensor for attachment to a person's wrist;

FIGS. **2***c* and **2***d* show front and back views of a hand and wrist with the sensor of FIGS. **2***a* and **2***b* attached;

FIG. **3** is a block diagram of an infrared biotelemetry transmitter;

FIG. **4** is a diagram of portions of the apparatus of FIG. **1**;

FIG. **5** is a diagram of an infrared telemetry receiver;

FIG. **6** is a schematic view of a particularly preferred embodiment of the present invention; and

FIG. **7** is an enlarged view of a portion of FIG. **6**.

DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

In the apparatus of FIG. **1**, signals representative of a parameter being sensed by a sensor are sent via an infrared link from a sensor and transmitter **1** to a receiver **9**.

The sensor comprises an attachable wrist-belt **2** (FIGS. **2***a* to **2***d*) carrying two pads which abut the skin and a microelectronic device to detect the galvanic skin resistance (GSR) of the wearer. The device is mounted in a watch-like case **3** and connected electrically to two rubber skin electrodes EL1 and EL2. A stabilised voltage Vref (FIG. **3**) is applied in series with resistors R1 and R2 and the two electrodes EL1 and EL2. When the wearer's skin resistance increases, the voltage between the electrodes and the output voltage V0 which feeds the input to a high impedance buffer amplifier **4**, both rise. A corresponding signal is emitted by infrared emitter diodes to be received by a receiver **9**.

Galvanic skin resistance levels can vary over a range of over 100 to 1. The simple input arrangement illustrated in detail in FIG. **3** offers two special benefits for GSR measurement. First, the output voltage never saturates, even though its response may be low at extreme resistance values; and second, over a useful resistance range of about 30 to 1, the output voltage responds approximately linearly to the logarithm of skin resistance. These features provide an orderly and stable compression of the large input parameter range, allowing satisfactory transmission within the rather restricted, typically 4 to 1, modulation range of the simple telemetry system used. Resistor R2 limits the minimum output voltage from the chain.

The convenience of this arrangement is valuable in GSR measurement and monitoring in contexts other than carrying out the method of operating a computer system noted above. The input circuit for providing a linear output corresponding substantially to the logarithm of GSR constitutes a further feature of the invention.

The output voltage V2 from the buffer amplifier feeds the input of the following voltage controlled oscillator **5** section which generates a square wave output of frequency proportional to V2. The oscillator **5** output frequency can vary from about 100 to 400 Hz corresponding to input extremes of zero and infinite resistance at the electrodes but generally lies within the 150 to 350 Hz range in normal operation.

The square wave output from the oscillator **5** is fed to the pulse forming stage **6** which generates a rectangular pulse of about 15 microseconds duration following every negative going transition of the oscillator **5** output waveform. This output pulse turns on a transistor driver stage **7** which delivers a 15 microsecond 0,6 A current pulse to infrared emitting diodes **8**. The transmitter is powered by a PP3 9V dry battery of about 400 mAH capacity allowing for at least 60 hours of operation before battery replacement.

The receiver **9** is mounted in a small plastics box to be placed on top of a computer screen **10** (FIG. **4**). Pulses of infrared radiation emitted by the transmitter **1** are detected by a reverse biased large area PIN photoelectrode **11** (FIG. **5**) with integral infrared filter.

Photocurrent from the detector diode is fed to the input of an infrared pre-amplifier integrated circuit **12**. The passband of this pre-amplifier is designed to reject the effects of unwanted infrared radiation, e.g. from sunlight, lighting fixtures and other interfering sources. A rectangular pulse of about 25 microseconds duration is generated at the pre-amplifier output following the reception of each pulse from the transmitter.

The pre-amplifier output pulses are fed to the input of a one-chip micro-controller **13** which counts the incoming pulses over a sampling period of about 95 milliseconds and then computes the corresponding pulse frequency to 12-bit precision. This value is then incorporated into two data bytes which are serially output from the micro-controller at a data rate of 9600 bits per second. Additional bits identify the most significant byte and flag the received signal quality.

A transistor line driver **14** then delivers this signal at the appropriate voltage levels through a receiver output cable **18** to a serial port RS232 of the host computer **10**. Output sample rate is 10 per second. Output values sent from the receiver retain the quasi-logarithmic relation to the subject skin resistance. This can be expanded by the host computer if desired.

The micro-controller **13** operating programme incorporates several measures to maintain very low noise levels and good output recovery characteristics in spite of the effects of interference and subject movement.

These include the rejection of pulses arriving at irregular intervals and the handling of periods of signal loss which occurs particularly when the pre-amplifier automatic gain control sub-system cannot adapt fast enough to sudden reductions in received pulse intensity following subject movement. Poor reception quality as determined by received pulse regularity and other criteria applied within the micro-controller programme is signalled by an auxiliary bit within the information sent to the host computer **10** as determined by a clock oscillator **19**.

The modest power requirements of the receiver are obtained from the host computer's communication port **15**, eliminating the need for a separate receiver power supply.

The data is received as a standard RS232 input and for data processing **20** (FIG. 1) is specially encoded. Meanwhile, possible errors are detected and corrected. Then data is decoded and separated into status and parametric data. The parametric data is fed as an input to the analysing systems, which coordinate with animation, audio and other specialised systems determined by the programme being run in the computer.

The analysing system stores the data, which can be used to create various types, graphs and charts. These can be used to profile, compare or monitor the subject's accomplishment on-line or during subsequent analysis sessions.

Software for the computer can provide for a variety of psychological testing systems. For example, in an animation system **21** (FIG. 1), data is used to manipulate various segments of the computer screen. Changes in input data produce changes in the speed and path of animation. The procession of images encourages the user to continue adding to the metamorphic sequence in a logical and aesthetic way.

The animation system allows for different layers of skill (beginner, novice and expert). This ensures the adaptation of the system to the particular variations of the user. Therefore achievement, i.e. evolution of images, will take place even before expertise is acquired. In an audio system **21** (FIG. 1), there can be an option to have an audio response which includes both music and voice. This will also be integrated with the psycho-physiological input.

For a tutorial system **22** (FIG. 1), tutorial software is provided for a high quality interactive course (courseware). It consists of: i) a graded series of interactive lessons on the subject to be learnt; and ii) a comprehensive database facility which the program searches for giving answers, proposing new questions or entering a specific sub-routine. The lessons may then be presented through window prompts and animated sequences. In advanced models with video interface cards or videodisc players, video sequences can overlay graphics and animation.

The information handled in the tutorial via the database system **23** can be prepared with the help of leading professionals in the appropriate fields. The system therefore provides not only a training facility, but also a counselling mode based on expert knowledge.

FIGS. **6** and **7** show a particularly preferred embodiment of the present invention, comprising a computer **30**, a monitor **32**, a receiver **34** and a sensor unit **36**.

Sensor unit **36** comprises a pair of non-invasive skin contact electrodes **38**, connected by wires and a jack plug **40** to a sensor box **42**. Sensor box **42** contains appropriate electronics (not shown) to convert the resistance between the electrodes **38** into a digital format signal. Sensor box **42** also contains switches **44** and infrared transmitters **46**.

Receiving unit **34** comprises receiver box **48** and a wire and connector **50**. The connector **50** connecting into a data entry port (not shown) on computer **30**. This may be a standard serial communications part. Receiver box **48** contains an infrared receiver (not shown) and electronics appropriate to convert received infrared signals into computer usable form.

In use, electrodes **38** are applied to adjacent finger of a user's hand **52** and held in position by way of a band surrounding both electrode and finger **54**. Band **54** is preferably of burr fastener material, but may be of any other suitable material. The electronics in sensor box **42**, powered by a power source also contained in sensor box **42** (not shown) periodically assess the skin resistance of the user's hand **52** via electrodes **38**. The electronics in sensor box **42** convert the readings of galvanic skin resistance into a data form suitable for transmission, and send the suitable data form to the infrared transmitters for transmission.

The infrared receiver in receiver box **48** receives the transmissions from infrared transmitters **46** and directs them to the electronics in receiver box **48**. There the data is converted into a form suitable for inputting into the computer **30** which is running under the control of an appropriate computer program. In this particular preferred embodiment, the software running on computer **30** is generating on monitor **32** an image of a fish **56** swimming over a seascape **58**. As the user becomes more relaxed, the user's galvanic skin resistance will rise. This will be detected by electrodes **38** and conveyed to the computer via sensor unit **36** and receiver unit **34**. The software will generate graphics showing the fish swimming from left to right on the screen. As the fish **56** swims further to the right relative to the seascape **58**, which scrolls to the left, the software is arranged to change the display so that the fish metamorphoses first into a mermaid then further into a human then an angel then a star. If, during this process, the user becomes less relaxed, so causing his galvanic skin resistance to drop, the fish, or whatever form it is at that time, travels to the left and the seascape scrolls to the right. The relative movement of fish **56** and seascape **58** enable the user to ascertain whether he or she is becoming more or less relaxed.

The software running on computer **30** may do more than simply show pictures of fishes **56** on seascapes **58**. Switches **44** on sensor box **42** may be used to exert overall control over the software. For example, buttons **44** might represent an escape button to move the user out of a particular aspect of a program and into a menu, a pair of direction buttons to move around that menu once entered and an enter button to make selections from the menu. Such buttons enable the use

of the customary keyboard forming part of the computer system to be dispensed with.

It will be obvious that the software running on computer **30** may have to set many different aspects relating to training, testing and assessment of the user.

Psycho-behavioural and Psychometric Test software may be used to programme the computer to provide a computerised testing facility which uses conventional methods of administration and interpretation. In addition, the system facilitates the on-line monitoring of psycho-physiological parameters. This last feature provides a method of detecting psycho-behavioural blockage-points during test completion. The interactive feedback of this information greatly enhances the training schedule.

It will be seen that the invention provides for all aspects of learning simultaneously in that it can involve the detection and analysis of both logic and intuitional processes; the first by monitoring "voluntary" action and the second by detecting "automatic" output. It uses psycho-physiological measurement principles to operate and interact with software applications by the use of an ergonomically designed sensor while the subject has freedom of movement and safety due to absence of actual contact between the subject and the computer.

We claim:

1. Apparatus for monitoring at least one psychophysiological parameter of at least one user's psychophysiological condition which provides an output display of a selected part of a continuous sequence of animated images viewable by said at least one user, the apparatus comprising a computer system; a program in the computer system adapted to store said sequence and to display a selected part of said sequence on a screen viewed by the at least one user; an input device comprising a sensor unit and receiver unit, wherein the sensor unit is adapted to monitor galvanic skin resistance of the at least one user and to transmit a value for said galvanic skin resistance monitored to the receiver unit, and wherein the receiver unit is adapted to input said value into the computer system; and software capable of using said value for said galvanic skin resistance as a control parameter to vary, in real time, the selected part of the sequence being displayed on said screen through continuing sequence in correspondence to the value thereby reflecting said at least one user's psychophysiological condition.

2. Apparatus according to claim **1** wherein the sensor unit is adapted to transmit data to the receiver unit via electromagnetic radiation.

3. Apparatus according to claim **2** wherein the electromagnetic radiation is in an infrared part of an electromagnetic spectrum.

4. Apparatus according to claim **3** wherein the receiver unit comprises a receiving diode, an infrared pre-amplifier and a micro-controller for converting received signals to a form acceptable to the computer system.

5. Apparatus as claimed in claim **1** wherein the sensor unit comprises non-invasive electrodes for applying to skin, circuitry appropriate to convert sensed skin resistance into digital data and means for transmitting the digital data to the receiving unit.

6. Apparatus according to claim **5** wherein the sensor unit is mounted on a wrist belt furnished with electrodes positioned to lie in contact with a wrist of the at least one user.

7. Apparatus according to claim **6** wherein the sensor unit is mounted in a case of a size to lie substantially within an area on the back of the wrist and contains a battery and microelectronic circuitry for forming pulses to be delivered to an infrared emitter diode.

* * * * *

US005933136A

United States Patent [19]

Brown

[11] Patent Number: 5,933,136

[45] Date of Patent: Aug. 3, 1999

[54] **NETWORK MEDIA ACCESS CONTROL SYSTEM FOR ENCOURAGING PATIENT COMPLIANCE WITH A TREATMENT PLAN**

[75] Inventor: **Stephen J. Brown**, Mountain View, Calif.

[73] Assignee: **Health Hero Network, Inc.**, Mountain View, Calif.

[21] Appl. No.: **08/771,951**

[22] Filed: **Dec. 23, 1996**

[51] **Int. Cl.**[6] **H04N 7/10**

[52] **U.S. Cl.** **345/327**; 348/5.5; 348/12; 348/13; 348/61; 705/2; 600/365

[58] **Field of Search** 345/327; 348/5.5, 348/2.1, 6, 12, 7, 8, 13, 61; 455/203.1, 3.2, 3.3, 4.2, 4.1, 5.1, 6.1, 6.2, 6.3; 705/2–4; 600/365; 434/247; H04N 7/10

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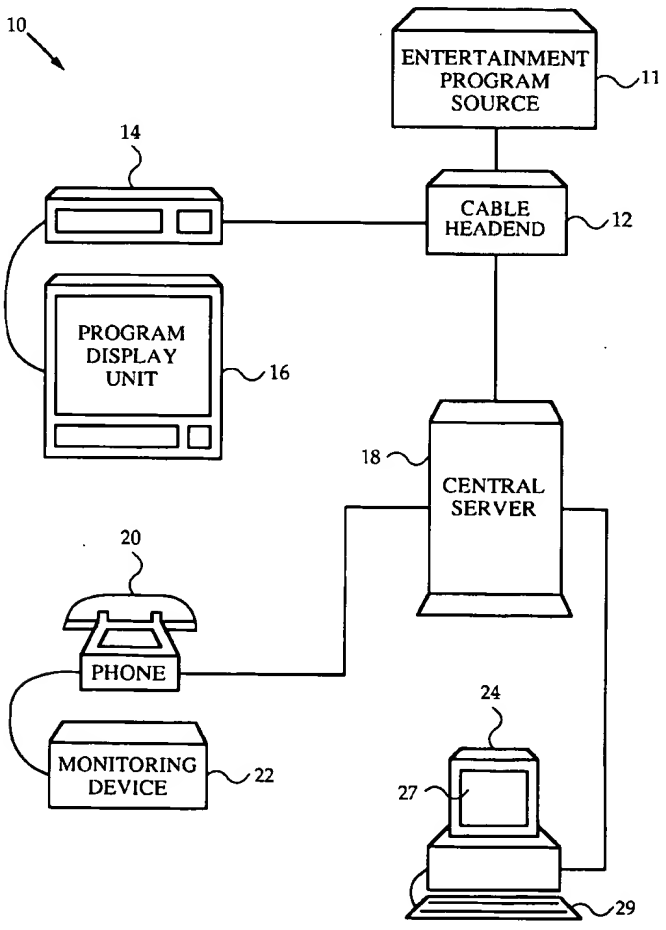
Primary Examiner—Nathan Flynn

Attorney, Agent, or Firm—Lumen Intellectual Property Services

[57] **ABSTRACT**

A system and method for controlling patient access to an entertainment program to encourage a patient to comply with a treatment plan. The method includes the step of collecting compliance data from the patient. In one embodiment, the compliance data includes measurements of a physiological condition of the patient as well as patient answers to compliance questions. The method further includes the step of comparing the compliance data to evaluation criteria selected by a healthcare provider to determine if the patient is in compliance with the treatment plan. If the patient is in compliance, access is granted to the entertainment program. If the patient is not in compliance, access to the entertainment program is restricted. In the preferred embodiment, the method includes the additional steps of transmitting and displaying the patient's compliance data and compliance status to the healthcare provider.

46 Claims, 14 Drawing Sheets



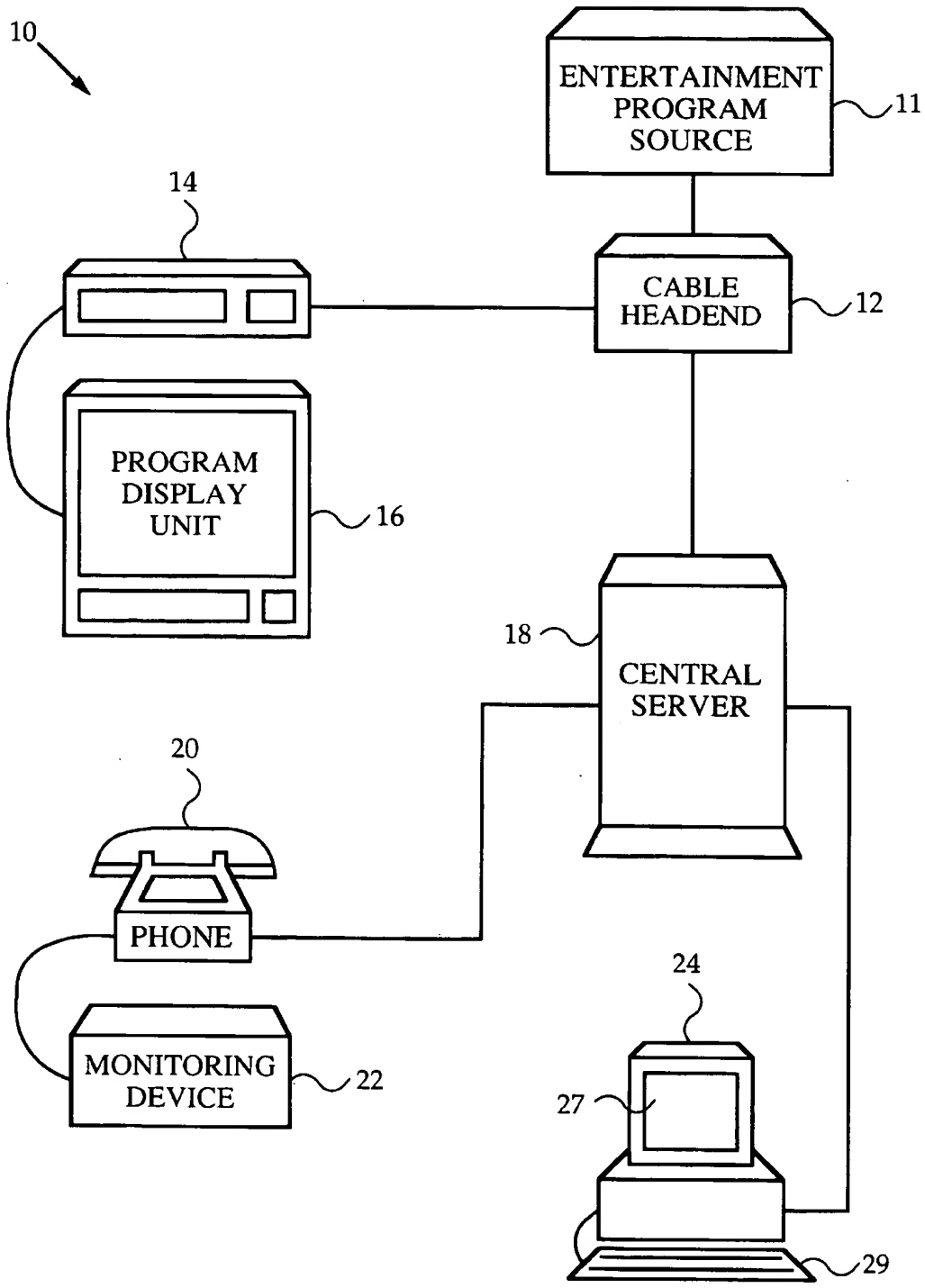

10
ENTERTAINMENT PROGRAM SOURCE
11
14
CABLE HEADEND
12
PROGRAM DISPLAY UNIT
16
18
CENTRAL SERVER
20
PHONE
MONITORING DEVICE
22
24
27
29

FIG. 1

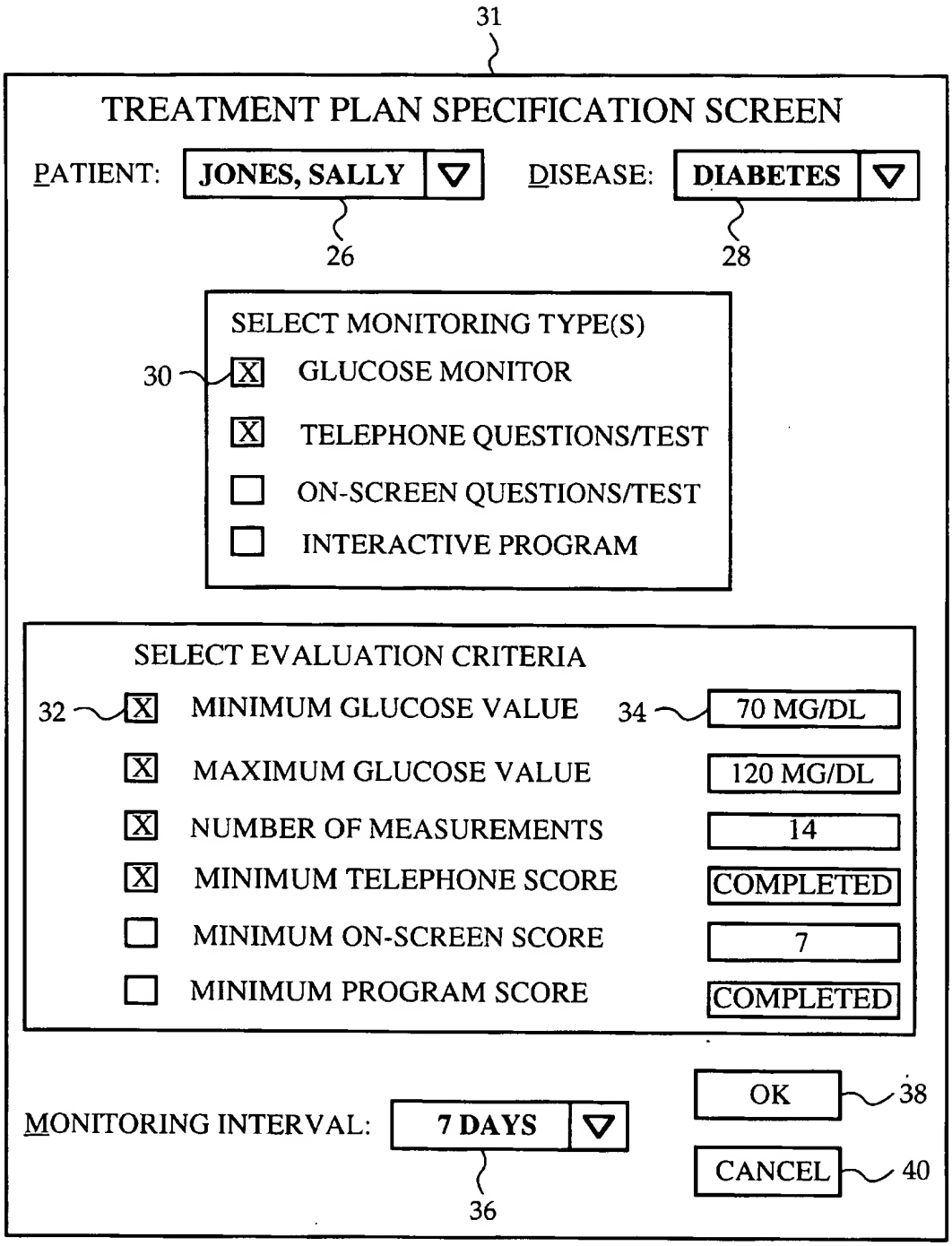

31
TREATMENT PLAN SPECIFICATION SCREEN
PATIENT:
JONES, SALLY
DISEASE:
DIABETES
26
28
SELECT MONITORING TYPE(S)
30
GLUCOSE MONITOR
TELEPHONE QUESTIONS/TEST
ON-SCREEN QUESTIONS/TEST
INTERACTIVE PROGRAM
SELECT EVALUATION CRITERIA
32
MINIMUM GLUCOSE VALUE
34
70 MG/DL
MAXIMUM GLUCOSE VALUE
120 MG/DL
NUMBER OF MEASUREMENTS
14
MINIMUM TELEPHONE SCORE
COMPLETED
MINIMUM ON-SCREEN SCORE
7
MINIMUM PROGRAM SCORE
COMPLETED
MONITORING INTERVAL:
7 DAYS
36
OK
38
CANCEL
40

FIG. 2

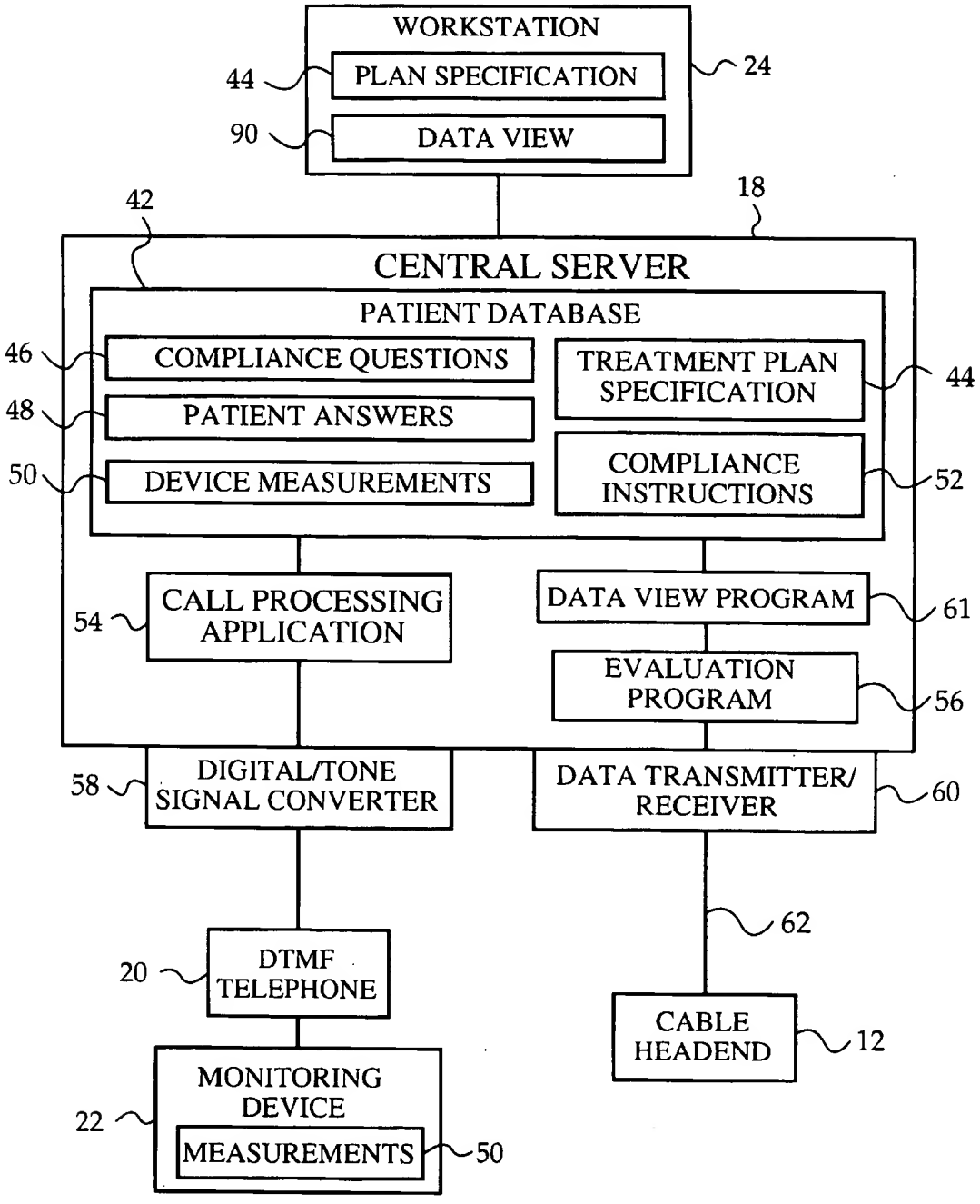

WORKSTATION
44
PLAN SPECIFICATION
24
90
DATA VIEW
42
18
CENTRAL SERVER
PATIENT DATABASE
46
COMPLIANCE QUESTIONS
TREATMENT PLAN SPECIFICATION
44
48
PATIENT ANSWERS
50
DEVICE MEASUREMENTS
COMPLIANCE INSTRUCTIONS
52
54
CALL PROCESSING APPLICATION
DATA VIEW PROGRAM
61
EVALUATION PROGRAM
56
58
DIGITAL/TONE SIGNAL CONVERTER
DATA TRANSMITTER/ RECEIVER
60
62
20
DTMF TELEPHONE
CABLE HEADEND
12
22
MONITORING DEVICE
MEASUREMENTS
50

FIG. 3

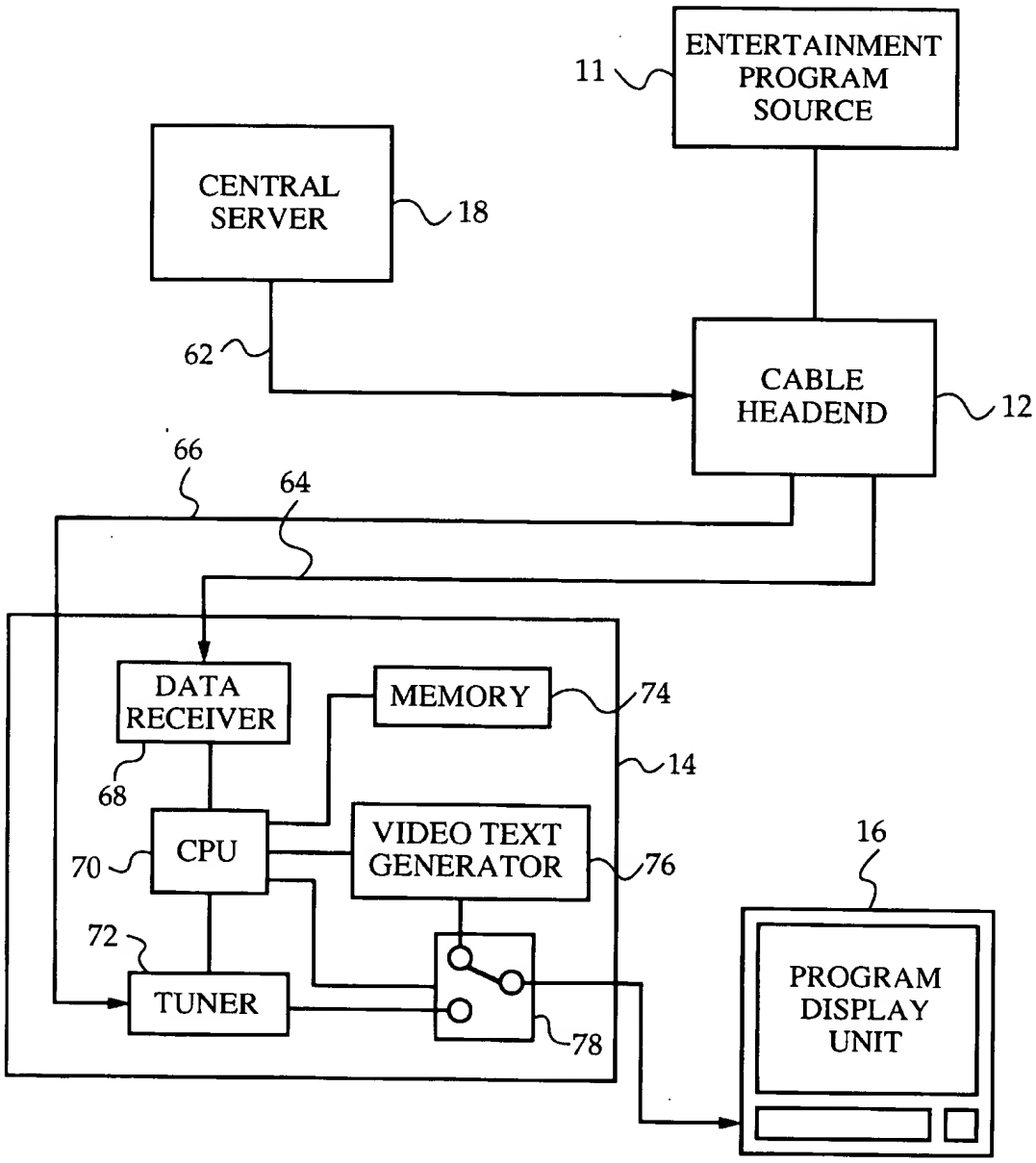

ENTERTAINMENT PROGRAM SOURCE
11
CENTRAL SERVER
18
62
CABLE HEADEND
12
66
64
DATA RECEIVER
68
MEMORY
74
14
CPU
70
VIDEO TEXT GENERATOR
76
16
72
TUNER
78
PROGRAM DISPLAY UNIT

FIG. 4

82

COMPLIANCE QUESTIONS SCRIPT

"THE FOLLOWING QUESTIONS ARE ON A SCALE OF 1 TO 5, WITH 1 BEING THE WORST OR LOWEST, 3 BEING AVERAGE OR MIDDLE, AND 5 BEING BEST OR GREATEST."

1. "ON A SCALE OF 1 TO 5, HOW WELL ARE YOU MANAGING YOUR DIABETES?"

2. "ON A SCALE OF 1 TO 5, HOW GOOD IS THE CARE YOU RECEIVE FROM THE DOCTOR WHO MANAGES YOUR DIABETES?"

3. "ON A SCALE OF 1 TO 5, HOW HARD IS IT FOR YOU TO FOLLOW YOUR TREATMENT PLAN?"

4. "ON A SCALE OF 1 TO 5, HOW WELL DOES YOUR DOCTOR UNDERSTAND AND RESPOND TO YOUR NEEDS?"

5. "ON A SCALE OF 1 TO 5, HOW HARD IS IT FOR YOU TO CONTROL YOUR BLOOD GLUCOSE LEVEL?"

"PLEASE ANSWER THE FOLLOWING QUESTIONS WITH A NUMERIC ANSWER."

6. "HOW MANY TIMES IN THE PAST 7 DAYS DID YOU HAVE BLOOD SUGAR THAT YOU FELT WAS TOO LOW?"

7. "HOW MANY TIMES IN THE PAST 7 DAYS DID YOU HAVE BLOOD SUGAR THAT YOU FELT WAS TOO HIGH?"

8. "HOW MANY TIMES IN THE PAST 7 DAYS DID YOU CONSULT YOUR DOCTOR ABOUT SOMETHING RELATED TO DIABETES? "

9. "HOW MANY TIMES PER DAY ON AVERAGE DID YOU TEST YOUR BLOOD SUGAR IN THE PAST 7 DAYS?"

10. "HOW MANY SICK DAYS DID YOU HAVE IN THE PAST 7 DAYS?"

FIG. 5

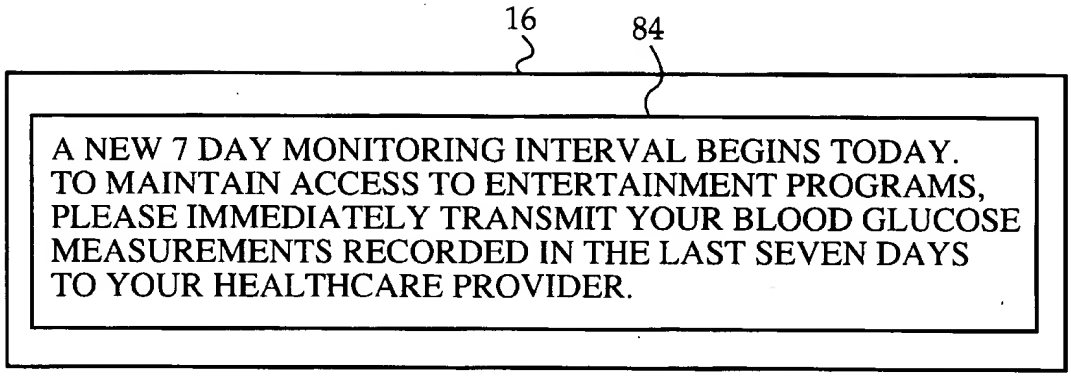


FIG. 6

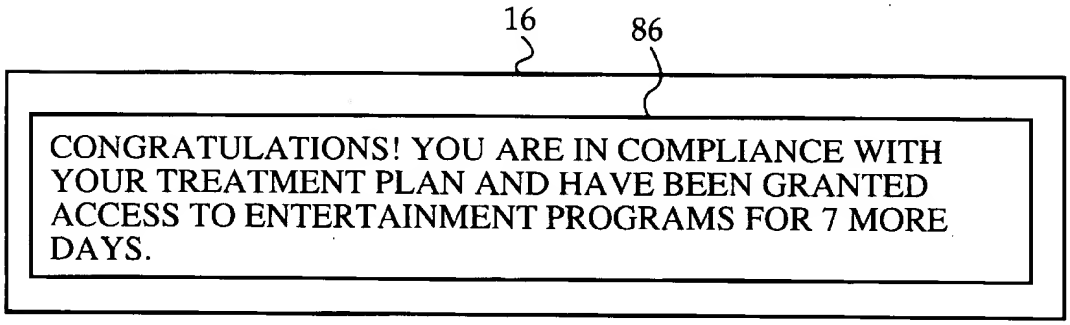


FIG. 7

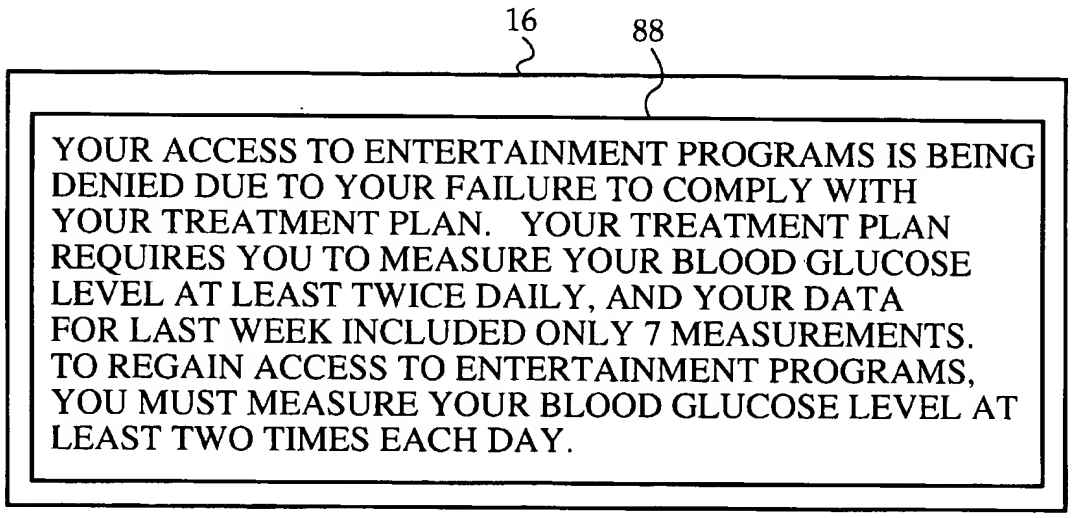


FIG. 8

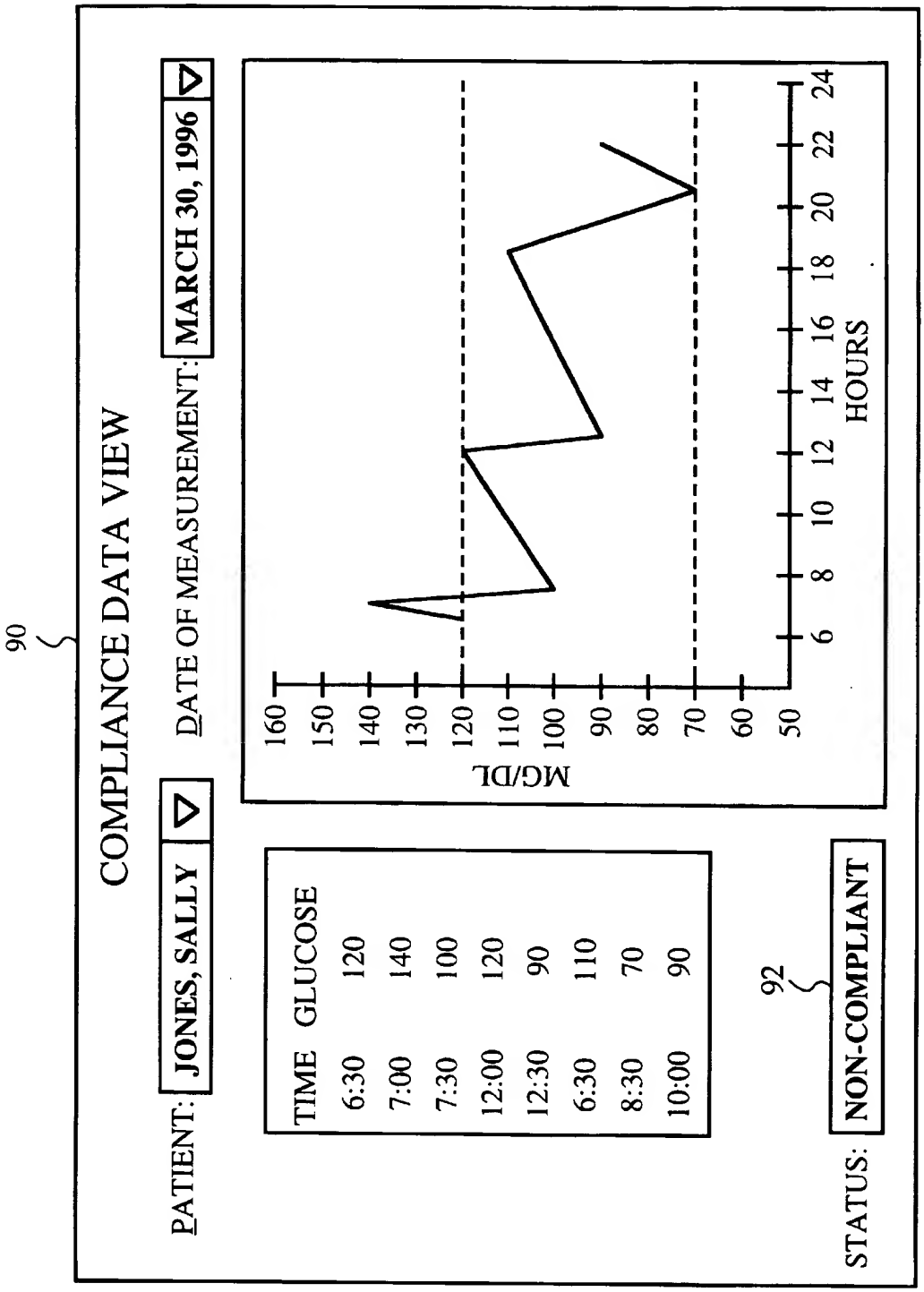

90
COMPLIANCE DATA VIEW
PATIENT: JONES, SALLY
DATE OF MEASUREMENT: MARCH 30, 1996
TIME GLUCOSE
6:30 120
7:00 140
7:30 100
12:00 120
12:30 90
6:30 110
8:30 70
10:00 90
92
STATUS: NON-COMPLIANT
MG/DL
160
150
140
130
120
110
100
90
80
70
60
50
6 8 10 12 14 16 18 20 22 24
HOURS

FIG. 9

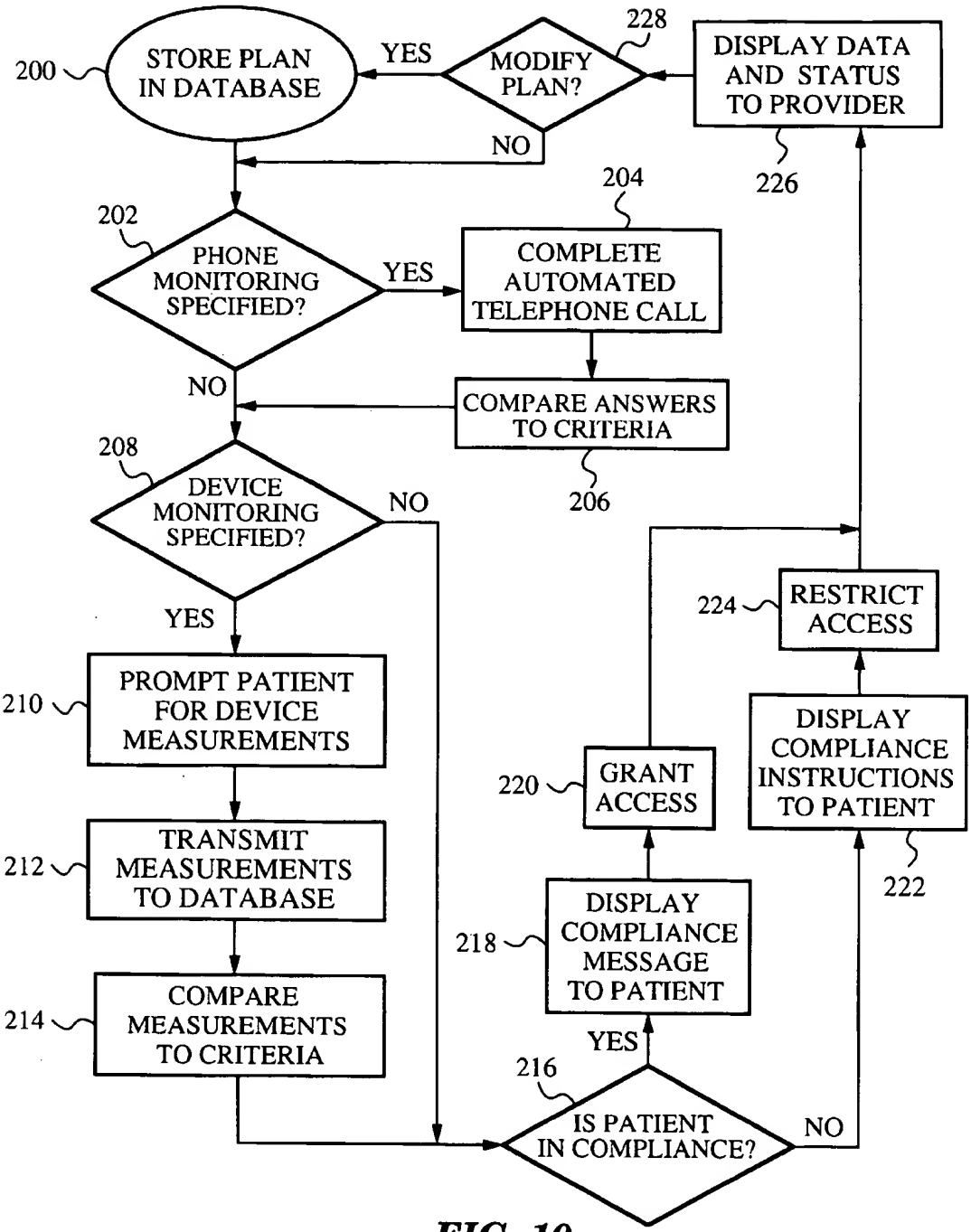

200
STORE PLAN IN DATABASE
YES
228
MODIFY PLAN?
DISPLAY DATA AND STATUS TO PROVIDER
226
NO
202
PHONE MONITORING SPECIFIED?
YES
204
COMPLETE AUTOMATED TELEPHONE CALL
NO
COMPARE ANSWERS TO CRITERIA
206
208
DEVICE MONITORING SPECIFIED?
NO
YES
224
RESTRICT ACCESS
210
PROMPT PATIENT FOR DEVICE MEASUREMENTS
DISPLAY COMPLIANCE INSTRUCTIONS TO PATIENT
222
220
GRANT ACCESS
212
TRANSMIT MEASUREMENTS TO DATABASE
218
DISPLAY COMPLIANCE MESSAGE TO PATIENT
214
COMPARE MEASUREMENTS TO CRITERIA
YES
216
IS PATIENT IN COMPLIANCE?
NO

FIG. 10

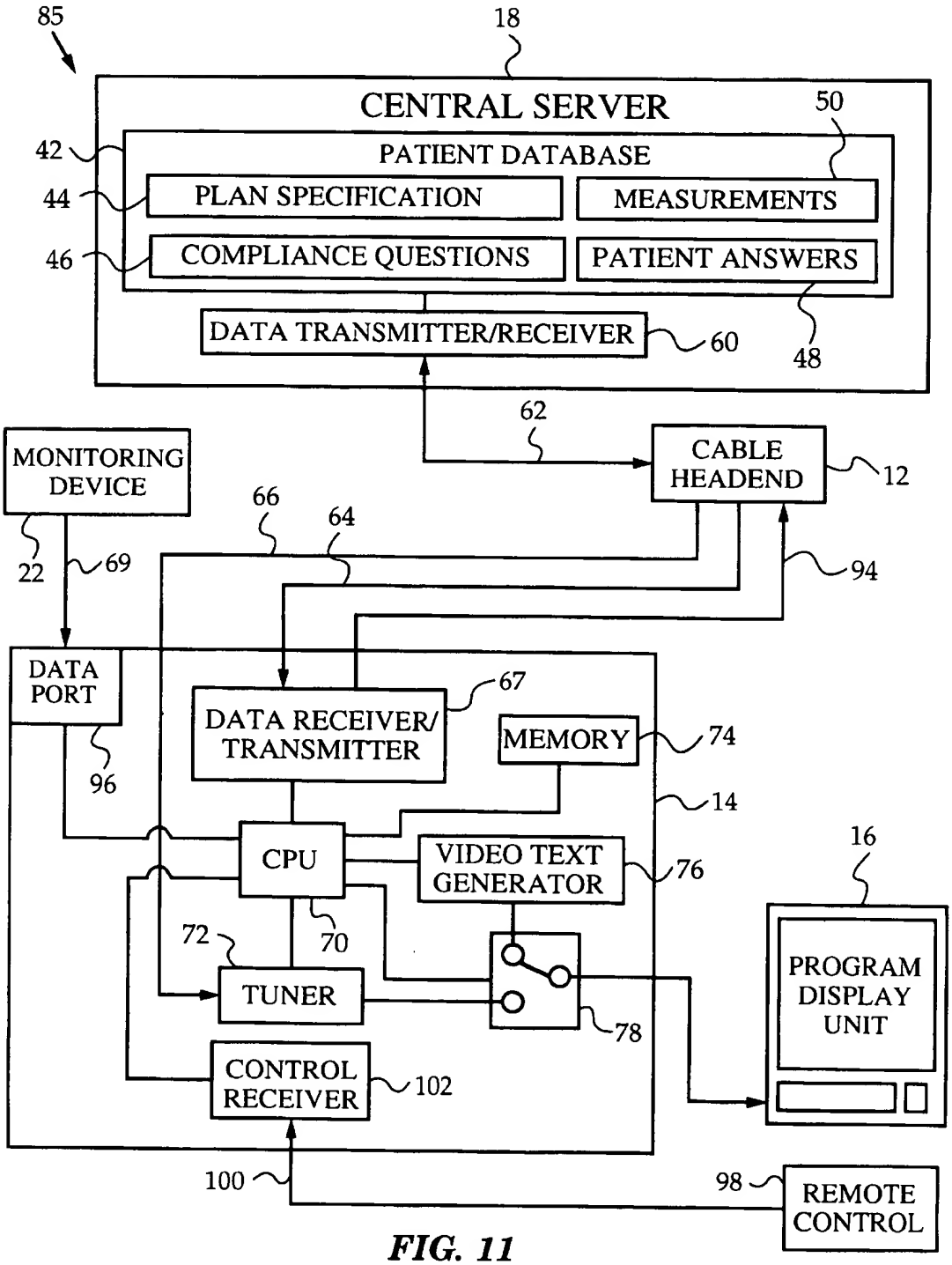

85
18
CENTRAL SERVER
50
42
PATIENT DATABASE
44
PLAN SPECIFICATION
MEASUREMENTS
46
COMPLIANCE QUESTIONS
PATIENT ANSWERS
48
DATA TRANSMITTER/RECEIVER
60
62
MONITORING DEVICE
CABLE HEADEND
12
66
64
22
69
94
DATA PORT
67
DATA RECEIVER/ TRANSMITTER
MEMORY
74
96
14
16
CPU
VIDEO TEXT GENERATOR
76
72
70
TUNER
78
PROGRAM DISPLAY UNIT
CONTROL RECEIVER
102
100
98
REMOTE CONTROL

FIG. 11

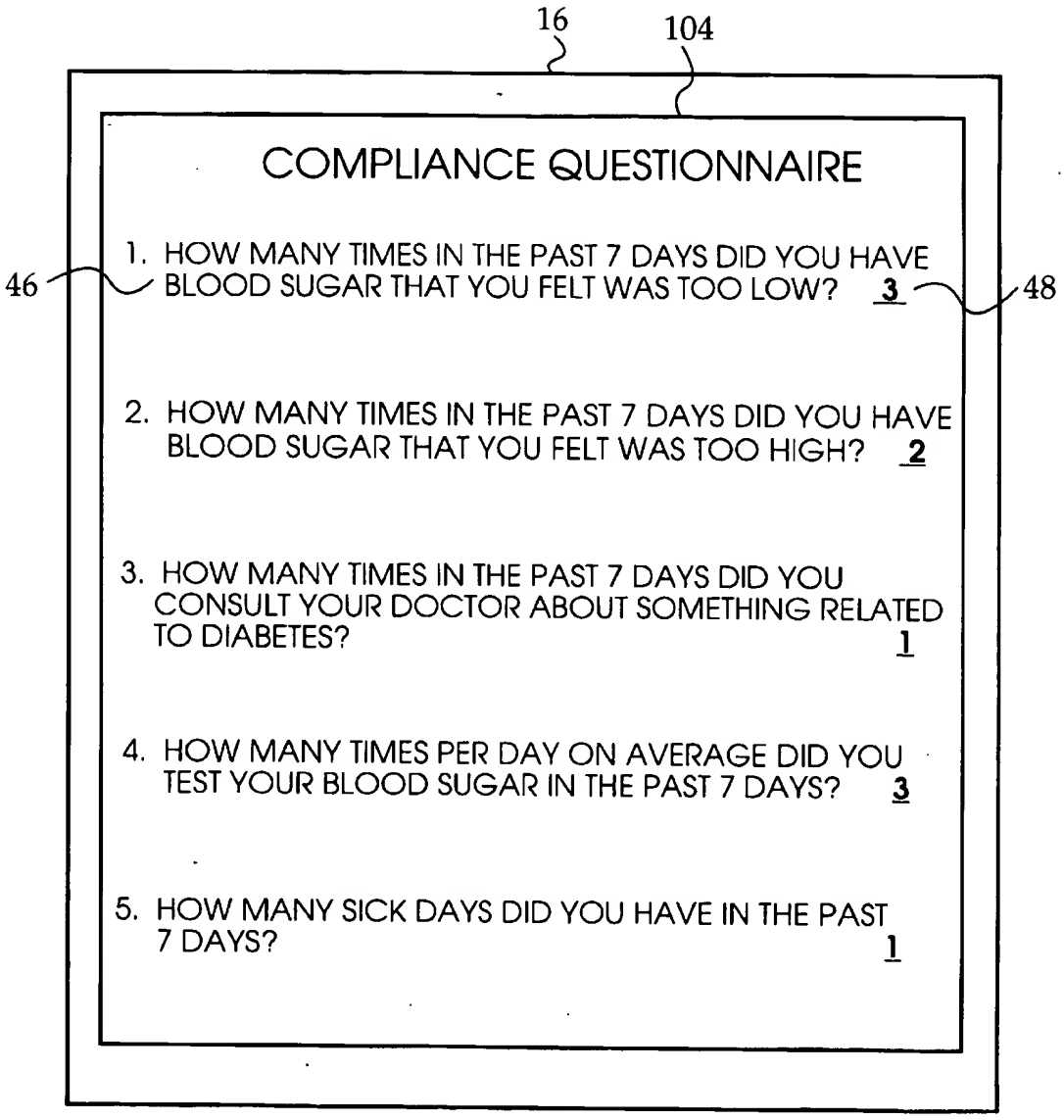

16
104
COMPLIANCE QUESTIONNAIRE
1. HOW MANY TIMES IN THE PAST 7 DAYS DID YOU HAVE BLOOD SUGAR THAT YOU FELT WAS TOO LOW? 3
46
48
2. HOW MANY TIMES IN THE PAST 7 DAYS DID YOU HAVE BLOOD SUGAR THAT YOU FELT WAS TOO HIGH? 2
3. HOW MANY TIMES IN THE PAST 7 DAYS DID YOU CONSULT YOUR DOCTOR ABOUT SOMETHING RELATED TO DIABETES? 1
4. HOW MANY TIMES PER DAY ON AVERAGE DID YOU TEST YOUR BLOOD SUGAR IN THE PAST 7 DAYS? 3
5. HOW MANY SICK DAYS DID YOU HAVE IN THE PAST 7 DAYS? 1

FIG. 12

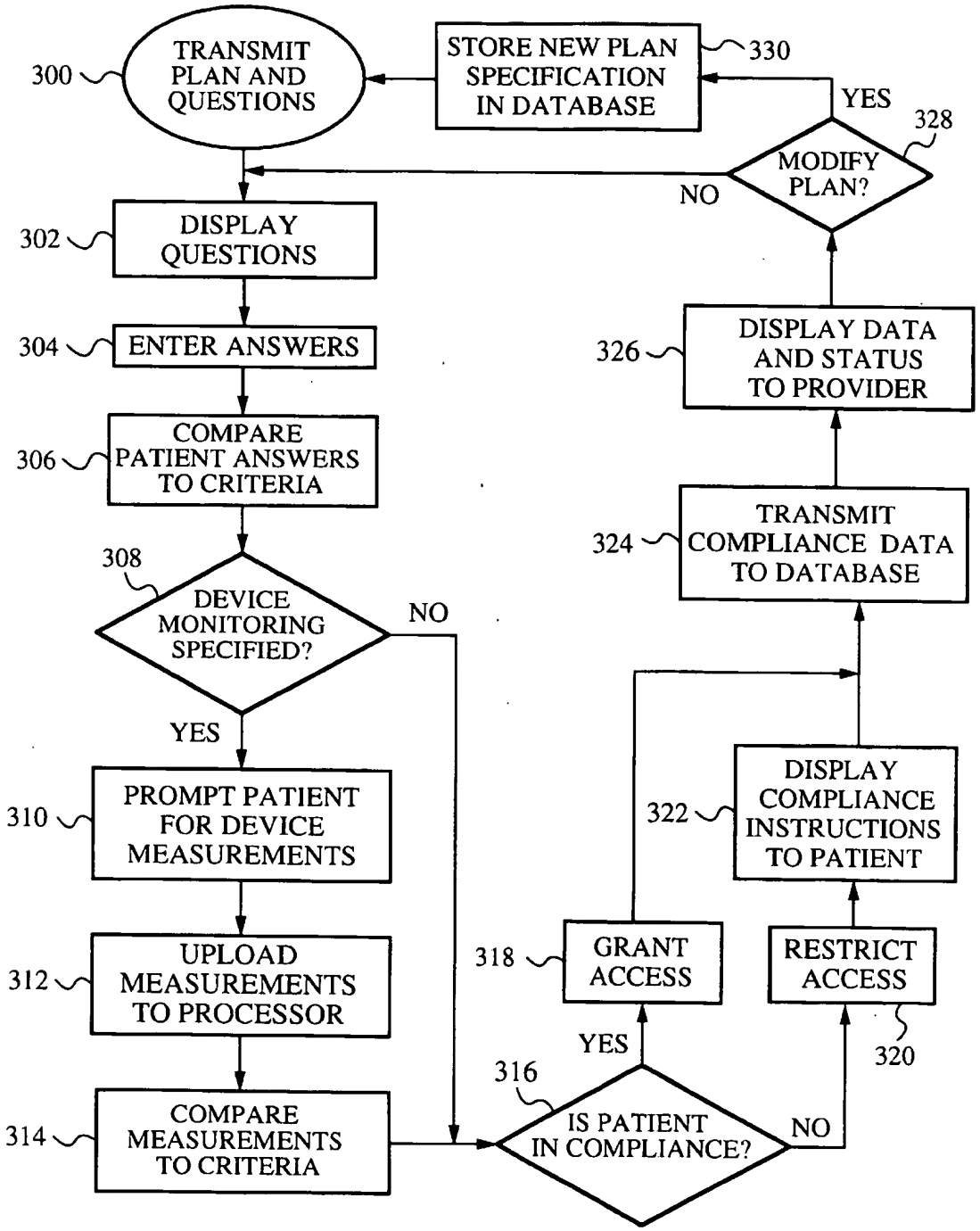

300
TRANSMIT PLAN AND QUESTIONS
STORE NEW PLAN SPECIFICATION IN DATABASE
330
YES
328
MODIFY PLAN?
NO
302
DISPLAY QUESTIONS
304
ENTER ANSWERS
306
COMPARE PATIENT ANSWERS TO CRITERIA
308
DEVICE MONITORING SPECIFIED?
NO
YES
310
PROMPT PATIENT FOR DEVICE MEASUREMENTS
312
UPLOAD MEASUREMENTS TO PROCESSOR
314
COMPARE MEASUREMENTS TO CRITERIA
316
IS PATIENT IN COMPLIANCE?
YES
NO
318
GRANT ACCESS
320
RESTRICT ACCESS
322
DISPLAY COMPLIANCE INSTRUCTIONS TO PATIENT
324
TRANSMIT COMPLIANCE DATA TO DATABASE
326
DISPLAY DATA AND STATUS TO PROVIDER

FIG. 13

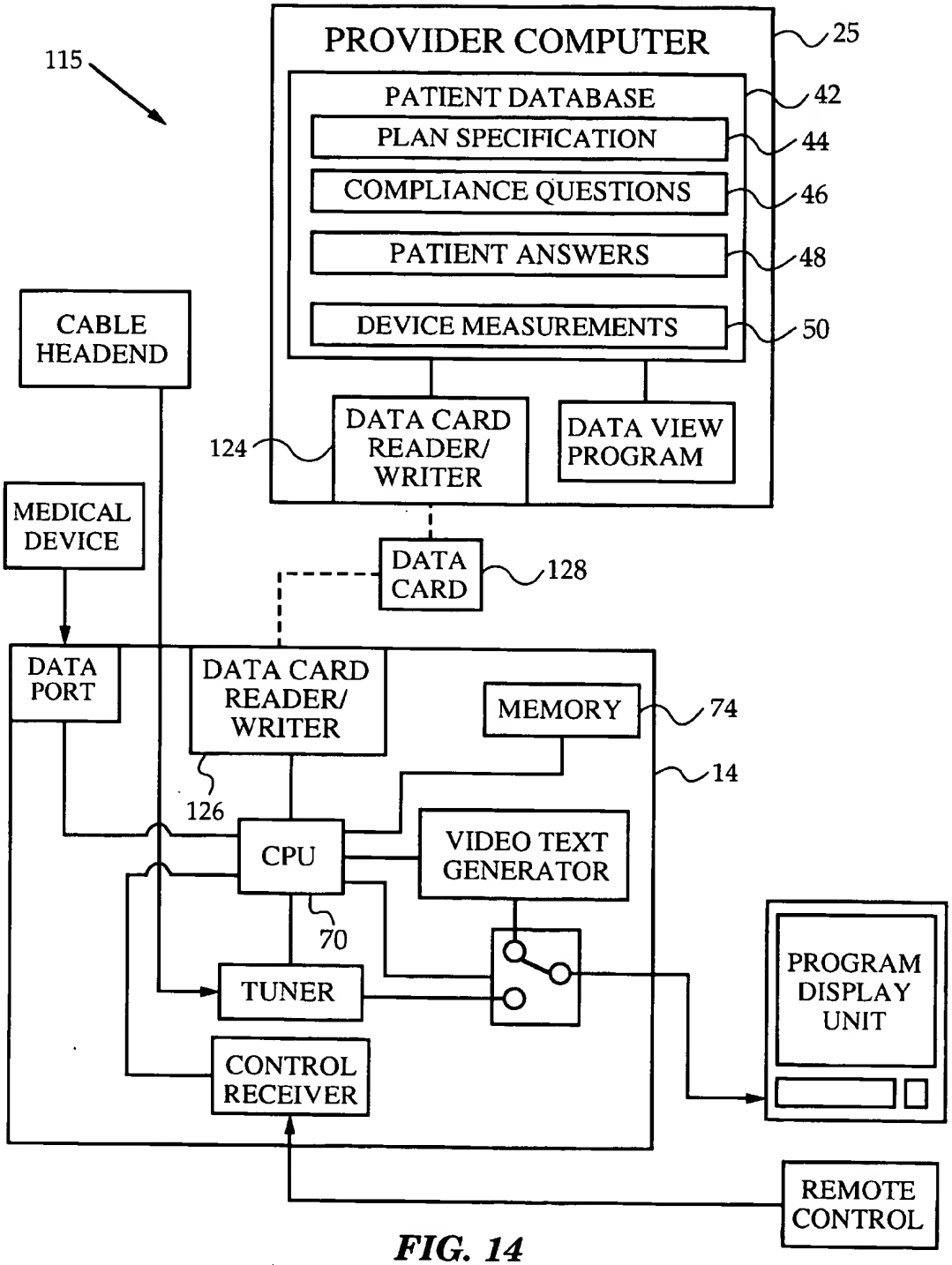

PROVIDER COMPUTER
25
115
PATIENT DATABASE
42
PLAN SPECIFICATION
44
COMPLIANCE QUESTIONS
46
PATIENT ANSWERS
48
DEVICE MEASUREMENTS
50
CABLE HEADEND
124
DATA CARD READER/ WRITER
DATA VIEW PROGRAM
MEDICAL DEVICE
DATA CARD
128
DATA PORT
DATA CARD READER/ WRITER
MEMORY
74
14
126
CPU
VIDEO TEXT GENERATOR
70
TUNER
PROGRAM DISPLAY UNIT
CONTROL RECEIVER
REMOTE CONTROL

FIG. 14

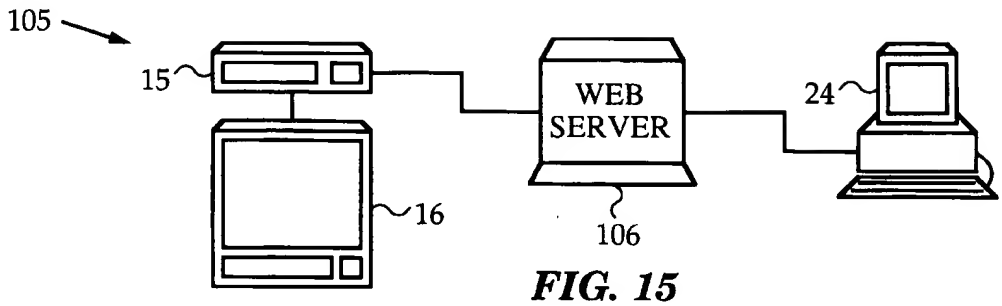

105
15
16
WEB SERVER
106
24

FIG. 15

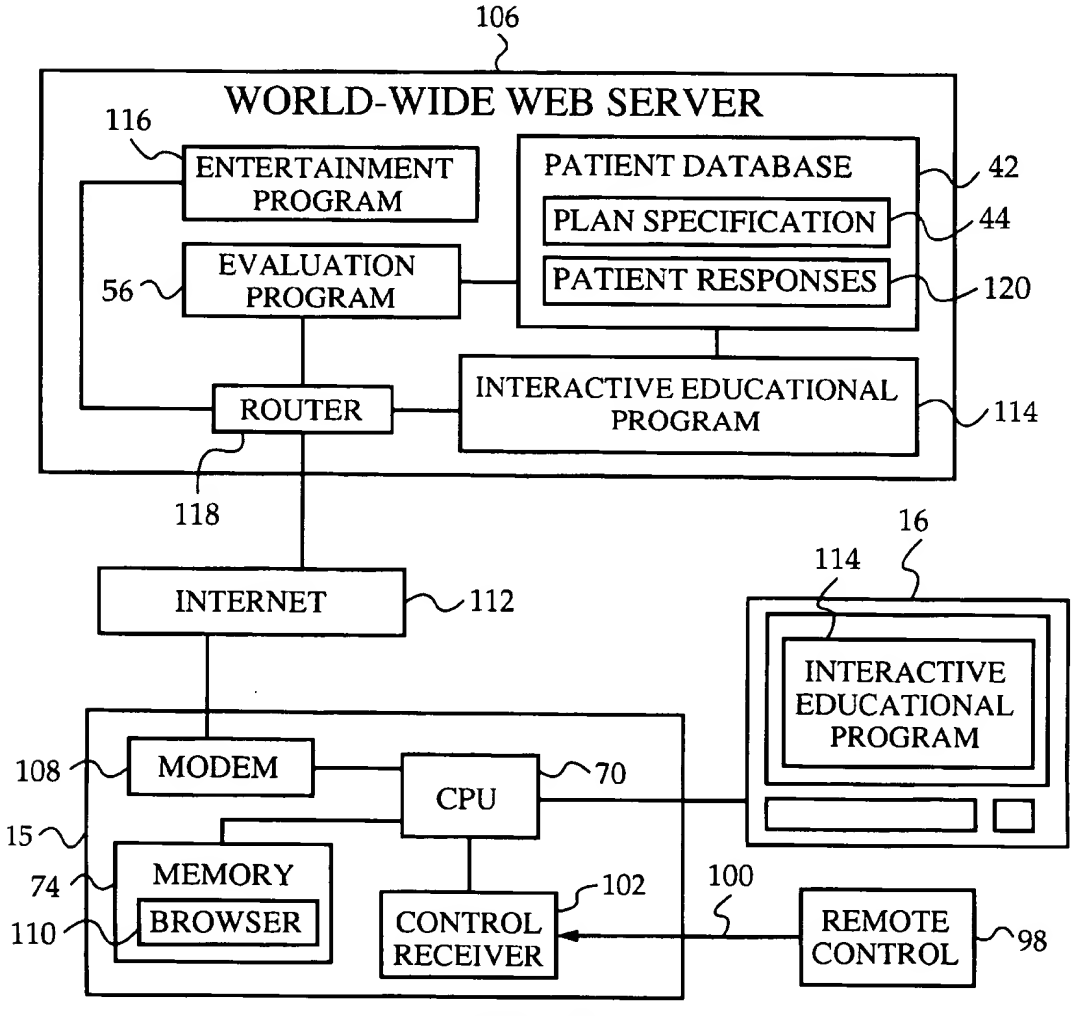

106
WORLD-WIDE WEB SERVER
116
ENTERTAINMENT PROGRAM
PATIENT DATABASE
42
PLAN SPECIFICATION
44
56
EVALUATION PROGRAM
PATIENT RESPONSES
120
ROUTER
INTERACTIVE EDUCATIONAL PROGRAM
114
118
16
114
INTERNET
112
INTERACTIVE EDUCATIONAL PROGRAM
108
MODEM
CPU
70
15
74
MEMORY
110
BROWSER
102
100
CONTROL RECEIVER
REMOTE CONTROL
98

FIG. 16

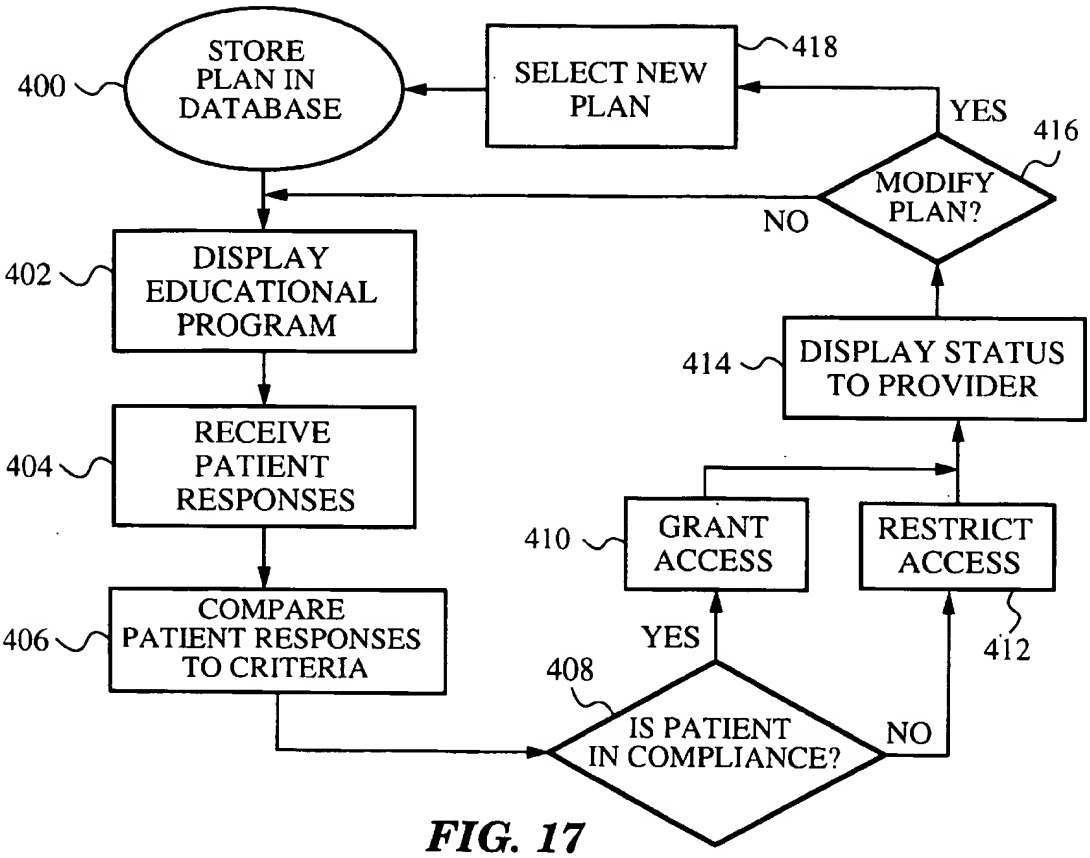

STORE PLAN IN DATABASE
400
SELECT NEW PLAN
418
YES
416
MODIFY PLAN?
NO
DISPLAY EDUCATIONAL PROGRAM
402
RECEIVE PATIENT RESPONSES
404
COMPARE PATIENT RESPONSES TO CRITERIA
406
DISPLAY STATUS TO PROVIDER
414
GRANT ACCESS
410
RESTRICT ACCESS
412
YES
408
IS PATIENT IN COMPLIANCE?
NO

FIG. 17

NETWORK MEDIA ACCESS CONTROL SYSTEM FOR ENCOURAGING PATIENT COMPLIANCE WITH A TREATMENT PLAN

BACKGROUND

1. Field of the Invention

The present invention relates generally to access control systems, and in particular to a system and method for controlling a patient's access to an entertainment program to encourage the patient to comply with a treatment plan for a health condition.

2. Description of Prior Art

In recent years, an increasing number of healthcare providers have initiated outpatient or home healthcare programs for their patients. The potential benefits of these home healthcare programs are particularly great for chronically ill patients, such as those suffering from diabetes or asthma, who must treat their diseases on a daily basis. However, the success of these home healthcare programs is currently limited by each patient's initiative and motivation to comply with a prescribed treatment plan for his or her disease.

The most common reason a patient fails to comply with a treatment plan is a lack of motivation to treat the disease when the disease is not causing an immediately recognizable affect. The primary affect of most diseases is pain, and once the pain stops, many patients ignore the disease until the pain returns. Of course, most healthcare issues can be addressed much more effectively through prevention. The challenge is in communicating the preventative concept to a patient in such a way that he or she will be motivated and encouraged to comply with a prescribed treatment plan.

A patient's lack of motivation to comply with a treatment plan also limits the ability of a healthcare provider to aid the patient in treating his or her disease. Many treatment plans require daily monitoring of a physiological condition of the patient, such as blood glucose levels in diabetes and peak flow rates in asthma. Since the patients themselves monitor these conditions in outpatient programs, the provider is often limited to learning each patient's status strictly through patient initiated events, such as an emergency visit or the delivery of the patient's latest medical data. Even with the current availability of remote monitoring devices that store and transmit medical data from a patient's home to a medical clinic, the provider must still wait for medical information whose arrival depends on the patient's initiative.

As a result, the majority of the provider's time is spent with the patients who are the most motivated and eager for treatment, while the greatest medical needs remain with the unmotivated patients who do not visit the provider or transmit their medical data. These unmotivated patients often develop urgent medical needs that could have been prevented with proper plan compliance. Consequently, the cost of treating their diseases is much higher than one might expect given the sophistication of current medical monitoring devices.

The prior art has not taught a restrictive access control system for encouraging a patient's compliance with a treatment plan. However, access control systems have been developed for controlling access to television programming based on the paying of a program fee or the desired censorship of programs containing subject matter deemed unsuitable for all viewers. For example, U.S. Pat. No. 4,768,229 issued to Benjamin et al. on Aug. 30, 1988 describes a restrictive access control system that includes a three-state switch for limiting television tuning access to only designated channels. U.S. Pat. No. 5,550,575 issued to West et al. on Aug. 27, 1996 discloses a viewer discretion television program control system which relies upon suitability ratings and personal identification numbers of household viewers to restrict television program access.

The systems described by Benjamin and West are not directed at motivating a patient to comply with a treatment plan, nor do they have any mechanism for monitoring a patient's compliance or for controlling program access in dependence upon the patient's compliance. Thus, none of the prior art systems for controlling access to an entertainment program encourage a patient to comply with a treatment plan, nor do they provide for remote monitoring of a patient's compliance.

OBJECTS AND ADVANTAGES OF THE INVENTION

In view of the above, it is an object of the present invention to provide a system and method for controlling a patient's access to an entertainment program to encourage the patient to comply with a prescribed treatment plan. It is another object of the invention to provide an access control system that encourages an unmotivated patient to monitor his or her condition and to transmit monitored data to a healthcare provider.

These and other objects and advantages will become more apparent after consideration of the ensuing description and the accompanying drawings.

SUMMARY OF THE INVENTION

The invention presents a system and method for controlling patient access to an entertainment program to encourage a patient to comply with a treatment plan. The method includes the step of collecting in an access control system patient compliance data for determining if the patient is in compliance with the treatment plan. In the preferred embodiment, the compliance data includes measurements of a physiological condition of the patient as well as patient answers to compliance questions.

The method further includes the step of storing in the access control system compliance evaluation criteria selected by a healthcare provider. The compliance data is compared to the evaluation criteria to determine if the patient is in compliance with the treatment plan. If the patient is in compliance, access is granted to the entertainment program. If the patient is not in compliance, access to the entertainment program is restricted. In the preferred embodiment, the method includes the additional step of displaying the patient's compliance data and compliance status to the healthcare provider.

A preferred system for implementing the method of the invention includes a program display unit for displaying an entertainment program to the patient. The system also includes a monitoring device for collecting patient compliance data and a memory for storing the compliance evaluation criteria. An evaluation program compares the compliance data to the evaluation criteria to determine if the patient is in compliance with the treatment plan. The system further includes an access control device in communication with the evaluation program for controlling access to the entertainment program in dependence upon the compliance status of the patient.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic block diagram of an access control system according to the invention.

FIG. 2 is a sample evaluation criteria entry screen.

FIG. 3 is a schematic block diagram of a central server of the access control system of FIG. 1.

FIG. 4 is a schematic block diagram of an access control device of the access control system of FIG. 1.

FIG. 5 is a sample compliance questions script according to the invention.

FIGS. 6–8 are sample messages appearing on the screen of a program display unit of the access control system of FIG. 1.

FIG. 9 is a sample compliance data view appearing on the screen of a provider workstation of the access control system of FIG. 1.

FIG. 10 is a flow chart illustrating steps included in a method of the invention.

FIG. 11 is a schematic block diagram of another access control system according to the invention.

FIG. 12 is a sample compliance questionnaire appearing on the screen of a program display unit of the access control system of FIG. 11.

FIG. 13 is a flow chart illustrating steps included in another method of the invention.

FIG. 14 is a schematic block diagram of another access control system according to the invention.

FIG. 15 is a schematic block diagram of another access control system according to the invention.

FIG. 16 is a schematic block diagram of a web server, television set-top processor, and program display unit of the access control system of FIG. 15.

FIG. 17 is a flow chart illustrating steps included in another method of the invention.

DESCRIPTION

The present invention is a system and method for controlling patient access to an entertainment program to encourage a patient to comply with a treatment plan. In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one of ordinary skill in the art that these specific details need not be used to practice the invention. In other instances, well known structures, interfaces, and processes are not shown in detail to avoid unnecessarily obscuring the present invention.

A preferred embodiment of the invention is illustrated in FIGS. 1–9. FIG. 1 is a schematic block diagram of an access control system **10** for controlling patient access to an entertainment program. The system includes an entertainment program source **11** for broadcasting the entertainment program to a local cable operator headend **12**. In the preferred embodiment, program source **11** is a satellite television broadcast system and the entertainment program is a television program. Headend **12** is connected via cable to a television set-top processor **14**, in the preferred embodiment a cable converter box.

Set-top processor **14** is connected to a program display unit, such as a television **16**, for displaying the television program to the patient. Specific techniques for establishing a cable television system in this manner are well known in the art. Although set-top processor **14** is illustrated as a separate device in FIG. **1**, those skilled in the art will appreciate that processor **14** may be built into the television or built into a video cassette recorder.

A central server **18** of a healthcare clinic is connected to headend **12** such that server **18** is in communication with set-top processor **14** through headend **12**. A DTMF telephone **20** is connected to server **18** via standard telephone lines. Telephone **20** is for collecting patient answers to compliance questions through an automated telephone call, as will be explained below. A medical monitoring device **22** is connected to telephone **20** such that monitoring device **22** is in signal communication with server **18** through telephone **20**.

Monitoring device **22** is capable of producing measurements of a physiological condition of the patient and recording the measurements for later transmission to server **18**. For example, for a diabetic patient, device **22** is a blood glucose meter for measuring the patient's blood glucose levels. For an asthmatic patient, device **22** is a peak flow meter for measuring the patient's peak flow rates. Such monitoring devices for recording and transmitting measurements are well known in the art. Further, those skilled in the art will appreciate that monitoring device **22** need not be connected to server **18** through telephone **22**. For example, in an alternative embodiment, monitoring device **22** is a wireless device having an RF transmitter for transmitting the measurements to server **18** through an RF link. In another embodiment, device **22** is connected to server **18** through a separate modem connection.

A workstation **24** of a healthcare provider is networked to central server **18**. Workstation **24** is preferably a personal computer or network terminal and includes a display **27** and a selection device **29**, such as a mouse or keyboard. Workstation **24** is for entering in server **18** a treatment plan specification including compliance evaluation criteria for evaluating a compliance of the patient with the treatment plan.

FIG. **2** illustrates a treatment plan specification screen **31** as it appears on display **27** of workstation **24**. Screen **31** includes a patient field **26** for specifying a patient to be evaluated and a disease field **28** for specifying the patient's disease. The preferred embodiment will be described with reference to a patient who has diabetes, although it is to be understood that the system may be used with patients having any type of health condition which requires a treatment plan.

Screen **31** includes check boxes **30** for selecting desired monitoring types. The monitoring types determine how the compliance of the patient with the treatment plan is to be monitored. For example, a diabetic patient may be monitored through a blood glucose meter, interactive telephone questions, on-screen questions, or an interactive educational program. This list of monitoring types represents a sample of the presently preferred monitoring types and is not intended to limit the scope of the access control system.

Screen **31** also includes check boxes **32** for selecting evaluation criteria corresponding to each monitoring type and data fields **34** for specifying criteria values. For example, FIG. **2** illustrates that the healthcare provider has selected glucose monitoring for the patient. The healthcare provider has also specified minimum glucose values, maximum glucose values, and a minimum number of glucose measurements the patient must make to comply with the treatment plan. The healthcare provider has further specified telephone question monitoring for the patient and a minimum score to be achieved by the patient in answering the questions. Screen **31** further includes a monitoring interval field **36** for specifying a desired monitoring interval, an OK button **38** for confirming the information entered in screen **31**, and a CANCEL button **40** for canceling the information entered in screen **31**.

FIG. **3** is a schematic block diagram illustrating server **18** in greater detail. Server **18** has a patient database **42** for

storing plan specification **44** received from workstation **24** and measurements **50** received from device **22**. Database **42** is further capable of storing compliance questions **46**, patient answers **48**, and compliance instructions **52**. Server **18** includes a call processing application **54** for placing an automated telephone call to the patient. Application **54** is designed to ask compliance questions **46** and receive patient answers **48** through telephone **20** and digital/tone signal converter **58**. A compliance questions script **82** containing sample compliance questions is shown in FIG. **5**. The programming of an automated call processing application to perform these functions is well known in the art.

Server **18** further includes a data view program **61**. Data view program **61** is designed to display device measurements **50** and a compliance status of the patient on the display of workstation **24**. FIG. **9** shows a sample data view **90** produced by the data view program illustrating a diabetic patient's compliance data. Data view **90** includes a graph of the device measurements, as well as a compliance status field **92** indicating the current compliance status of the patient. Specific techniques for creating a data view program to display data in this manner are well known in the art.

Referring again to FIG. **3**, server **18** additionally includes an evaluation program **56**. Evaluation program **56** is designed to compare the compliance data received in database **42** to the evaluation criteria specified in plan specification **44** to determine a compliance status of the patient. Evaluation program **56** also includes program logic for performing various control functions described in the operation section below. Specific techniques for creating an evaluation program to perform the control functions described are well known in the art.

Server **18** is connected to a data transmitter/receiver **60** for transmitting data to headend **12** and receiving data from headend **12** through a data link **62**. It will be apparent to one skilled in the art that data link **62** may comprise a telephone line, radio signal link, satellite link, or any other suitable link for transmitting data between a server and a cable headend.

FIG. **4** is a schematic block diagram illustrating the interaction of headend **12**, set-top processor **14**, and television **16** in greater detail. Headend **12** is designed to receive television program signals from program source **11** and relay the program signals to set-top processor **14** through a signal path **66**. Headend **12** is further designed to receive data signals from server **12** through link **62** and relay the data signals to set-top processor **14** through a signal path **64**. It will be apparent to one skilled in the art that signal paths **64** and **66** may be located in the same transmission cable connecting set-top processor **14** to headend **12**.

Set-top processor **14** has a television tuner **72** for receiving the television program signals from signal path **66**. Set-top processor **14** also has a data receiver **68** for receiving the data signals from signal path **64** and for relaying the data signals to a microprocessor **70**. A memory **74** and a video text generator **76** are connected to microprocessor **70**. Set-top processor **14** also includes a switch **78** controlled by microprocessor **70**. The switch has a first position for connecting generator **76** to television **16** and a second position for connecting tuner **72** to television **16**. Generator **76** is designed to generate text messages for display on television **16**. Sample text messages are shown in FIGS. **6–8** and will be explained in detail below.

The operation of the preferred embodiment is illustrated in FIG. **10**. FIG. **10** is a flow chart showing a preferred method of using access control system **10** to encourage the patient to comply with the treatment plan. In step **200**, plan specification **44** is selected by a healthcare provider and stored in database **42**. The healthcare provider stores plan specification **44** including the selected evaluation criteria in database **42** by completing screen **31** on workstation **24** and pressing OK button **38**, as shown in FIG. **2**.

Next, evaluation program **56** determines if the healthcare provider specified telephone monitoring for the patient, decision step **202**. If telephone monitoring is not specified, evaluation program **56** proceeds to decision step **208**. If telephone monitoring is specified, call processing application **54** completes an automated telephone call to the patient, step **204**. Call processing application **54** places the call to the patient through telephone **20** and asks compliance questions **46**. The patient answers the questions using the touch tone key pad of telephone **20**. Patient answers **48** are received through converter **58** and stored in database **42**. Next, evaluation program **56** compares patient answers **48** to the evaluation criteria specified in plan specification **44**, step **206**.

As shown in FIG. **2**, the healthcare provider specified that the compliance questions need only be completed by the patient to be in compliance. In an alternative embodiment, the healthcare provider may enter a minimum numeric score the patient must achieve to be in compliance. In this embodiment, the evaluation program includes program logic for scoring the patient answers and for comparing the patient's score to the minimum score specified by the healthcare provider.

The advantage of merely requiring the patient to provide complete answers to the compliance questions is that it removes the temptation for the patient to be untruthful in his or her answers in an effort to achieve a false compliance status. It is a significant advance in healthcare to motivate a patient to supply information to a healthcare provider on a regular basis, even if the information indicates that the patient is having difficulty with the treatment plan. Thus, in the preferred embodiment, the patient is deemed to be in compliance if the patient provides complete answers to the compliance questions

Following step **206**, evaluation program **56** proceeds to decision step **208**, determining if the healthcare provider specified device monitoring for the patient. If device monitoring is not specified, evaluation program **56** proceeds to decision step **216**. If device monitoring is specified, evaluation program **56** proceeds to step **210**, prompting the patient to transmit measurements **50** to server **18**.

To prompt the patient, server **18** transmits prompt signals to set-top processor **14** through link **62** and path **64**, as shown in FIG. **4**. The prompt signals include prompt data used by text generator **76** to generate a prompting message on television **16**. Microprocessor **70** places switch **78** in its first position to connect text generator **76** to television **16**. Generator **76** then produces a prompt message **84** which is displayed on television **16**, as shown in FIG. **6**.

Upon reading the prompt, the patient transmits measurements **50** from monitoring device **22** to central server **18**, step **212**, and the measurements are stored in database **42**. Evaluation program **56** then compares the measurements to the criteria values specified by the healthcare provider, step **214**. In step **216**, evaluation program **56** determine a compliance status of the patient based on the comparison of measurements **50** and patient answers **48** to the corresponding criteria values specified by the healthcare provider. If the patient is in compliance, a compliance message is displayed to the patient, step **218**, and access is granted to the television program, step **220**.

To display the compliance message and grant access to the television program, server **18** transmits compliance message signals and a grant access control signal to set-top processor **14** through link **62** and path **64**, as illustrated in FIG. **4**. The compliance message signals include compliance message data used by text generator **76** to generate the compliance message on television **16**. Microprocessor **70** places switch **78** in its first position to connect text generator **76** to television **16**. Generator **76** then produces a compliance message **86** which is displayed on television **16**, as shown in FIG. **7**. The grant access control signal instructs microprocessor **70** to place switch **78** in its second position following the display of message **86**. In its second position, switch **78** connects tuner **72** to television **16** so that the patient has access to the television program.

If the patient is not in compliance, an instructional message is displayed to the patient, step **222**, and access is restricted to the television program, step **224**. To display the instructional message and restrict access to the television program, server **18** transmits instruction signals and a restrict access control signal to set-top processor **14**. The instruction signals include instructional message data used by text generator **76** to generate the instructional message on television **16**. Microprocessor **70** places switch **78** in its first position to connect text generator **76** to television **16**. Generator **76** then produces the instructional message which is displayed on television **16**.

FIG. **8** shows a sample instructional message **88** as it appears on television **16**. Message **88** contains an explanation of why access to the entertainment program is being restricted and compliance instructions which include a description of an action the patient must perform to satisfy the evaluation criteria. The restrict access control signal instructs microprocessor **70** to maintain switch **78** in its first position following the display of message **88**. In its first position, switch **78** disconnects tuner **72** from television **16** so that the patient is denied access to the television program.

In step **226**, the compliance data and compliance status of the patient are displayed to the healthcare provider in compliance data view **90**, as shown in FIG. **9**. Next, the health care provider determines if he or she wishes to modify the patient's treatment plan specification, decision step **228**. If the healthcare provider desires to modify the plan specification, he or she returns to step **200**, storing the plan specification in the database. If the healthcare provider does not desire to modify the plan specification, evaluation program **56** returns to step **202** and continues the monitoring loop at the specified monitoring interval.

FIGS. **11–12** illustrate a second embodiment of the invention. The second embodiment differs from the preferred embodiment in that the evaluation program is stored and executed in the set-top processor rather than the server. Thus, in the second embodiment, the compliance status of the patient is determined by the set-top processor rather than the server.

Referring to FIG. **11**, an access control system **85** includes a set-top processor **14** having a microprocessor **70** and a memory **74**. Memory **74** stores the evaluation program to be executed by microprocessor **70** to determine a compliance status of the patient and to perform the control functions described in the operation section below. The programming of a microprocessor to perform the functions described is well known in the art. Memory **74** further stores compliance instructions for the patient and prompt data used by text generator **76** to produce prompting messages for display on television **16**.

The second embodiment also differs from the preferred embodiment in that the patient is asked compliance questions through television **16** rather than through an automated telephone call. System **85** includes a user input device, such as remote control **98**, for entering patient answers to the compliance questions. Remote control **98** is preferably a standard infrared remote for generating infrared signals **100**. Set-top processor **14** has a control receiver **102** connected to microprocessor **70** for receiving infrared signals **100** from remote control **98**.

The second embodiment further differs from the preferred embodiment in that monitoring device **22** is connected to set-top processor **14** rather than server **18**. Set-top processor **14** has a data port **96** connected to memory **74** through microprocessor **70**. Device **22** is connected to data port **96** through a connection cord **69** such that measurements **50** may be uploaded to microprocessor **70** for storage in memory **74**. Set-top processor **14** further includes a data receiver/transmitter **67** for receiving data input signals from headend **12** through signal path **64** and for transmitting data output signals to headend **12** through a signal path **94**. Signal paths **64** and **94** are preferably located in the same transmission cable connecting set-top processor **14** to headend **12**.

The operation of the second embodiment is shown in FIG. **13**. FIG. **13** is a flow chart showing a preferred method of using access control system **85** to encourage a patient to comply with a treatment plan. In step **300**, plan specification **44** and compliance questions **46** are transmitted from server **18** to set-top processor **14** through link **62** and signal path **64**. Plan specification **44** and compliance questions **46** are received by receiver/transmitter **67** and stored in memory **74**. In step **302**, text generator **76** produces a compliance questionnaire which is displayed to the patient on television **16**. FIG. **12** illustrates a sample compliance questionnaire **104** containing compliance questions **46**.

The patient enters answers **48** to compliance questions **46** using remote control **98**, step **304**. The patient answers are received through control receiver **102** and stored in memory **74**. Microprocessor **70** compares the patient answers to the criteria specified in plan specification **44**, step **306**. Next, microprocessor **70** determines if plan specification **44** specifies device monitoring for the patient, decision step **308**. If device monitoring is not specified, microprocessor **70** proceeds to decision step **316**. If device monitoring is specified, microprocessor **70** proceeds to step **310**, prompting the patient to upload device measurements **50** to set-top processor **14**.

To prompt the patient, text generator **76** generates a prompt message which is displayed on television **16** asking the patient to upload measurements **50** to set-top processor **14**. The patient then uploads the measurements from monitoring device **22** to set-top processor **14** through cord **69**, step **312**. The measurements are received through data port **96** and stored in memory **74**.

In step **314**, microprocessor **70** compares the measurements to the criteria values specified in plan specification **44**. In step **316**, microprocessor **70** determines a compliance status of the patient based on the comparison of measurements **50** and patient answers **48** to the corresponding criteria values specified in plan specification **44**, decision step **316**. If the patient is in compliance, access is granted to the desired television program, step **318**. To grant access, microprocessor **70** positions switch **78** in its second position to connect tuner **72** to television **16**. Microprocessor **70** then proceeds to step **324**.

If the patient is not in compliance, access is restricted to the television program, step **320**, and the compliance instructions are displayed to the patient on television **16**, step **324**. To restrict access to the television program and display the compliance instructions, microprocessor **70** places switch **78** in its first position to connect text generator **76** to television **16**.

Generator **76** then produces an instructional message which is displayed on television **16**. As described in the preferred embodiment above, the message contains an explanation of why access to the entertainment program is being restricted and compliance instructions which include a description of an action the patient must perform to satisfy the evaluation criteria. Microprocessor **70** maintains switch **78** in its first position following the display of the message so that the patient is denied access to the television program.

In step **324**, the device measurements, patient answers, and compliance status of the patient are transmitted from set-top processor **14** to server **18** through signal path **94** and link **62**. The compliance status, measurements, and patient answers are stored in database **42**. The remaining operation of the second embodiment is analogous to the operation of the preferred embodiment described above.

Although the second embodiment has been described with the central server communicating with the set-top processor through the cable headend, it is obvious that the central server could also be connected directly to the set-top processor through telephone lines, or a similarly suitable network connection. Communication through the cable headend is presently preferred so that the set-top processor need only have one network connection, but it is anticipated that the central server may be in direct communication with the set-top processor.

FIG. **14** shows a third embodiment of the invention. The third embodiment is similar in design and operation to the second embodiment described above. However, the third embodiment differs from the second embodiment in that the central server and workstation are replaced by a single healthcare provider computer. The third embodiment also differs from the second embodiment in that data is transferred between the set-top processor and provider computer using a data storage card rather than network connections.

As shown in FIG. **14**, an access control system **115** includes a healthcare provider computer **25**, preferably a personal computer. Computer **25** includes patient database **42** for storing plan specification **44**, compliance questions **46**, patient answers **48**, and device measurements **50**. Computer **25** also includes a data card reader/writer **124** for receiving a data storage card **128**, such as a smart card or computer disk. Reader/writer **24** is designed to read data from card **128** and write data to card **128**. Set-top processor **14** has a corresponding card reader/writer **126** for reading data from card **128** and writing data to card **128**.

The operation of the third embodiment is analogous to the operation of the second embodiment previously described with reference to FIG. **13**. The operation of the third embodiment differs only in step **300**, transmitting plan specification **44** and compliance questions **46** to set-top processor **14**, and step **324**, transmitting the compliance data to database **42**. In the third embodiment, step **300** is performed by writing plan specification **44** and compliance questions **46** on card **128** using reader/writer **124** of provider computer **25**. The healthcare provider typically performs this step during a patient office visit. The patient then takes card **128** to set-top processor **14** and inserts card **128** in reader/writer **126**. Plan specification **44** and compliance questions **46** are then read and stored in memory **74**.

Similarly, step **302** is performed by writing patient answers **48** and measurements **50** on card **128** using reader/writer **126** of set-top processor **14**. The patient then takes card **128** to the healthcare provider. The healthcare provider inserts card **128** in reader/writer **124**. Patient answers **48** and measurements **50** are then read and stored in database **42**. Other than the differences described, the operation of the third embodiment is the same as the operation of the second embodiment described above.

A fourth embodiment of the invention is illustrated in FIGS. **15–16**. The fourth embodiment differs from the preferred embodiment in that the entertainment program source is a world wide web server and the entertainment program is a web entertainment program. Referring to FIG. **15**, an access control system **105** includes a web server **106** connected to a web television set-top processor **15**. Set-top processor **15** is connected to television **16** such that television **16** displays to the patient world wide web programs accessed through set-top processor **15**. Workstation **24** is networked to web server **106** for entering in web server **106** plan specification **44**.

The fourth embodiment also differs from the preferred embodiment in that the compliance data collected from the patient includes patient responses to an interactive educational program. Referring to FIG. **16**, web server **106** includes an interactive educational program **114** for teaching the patient proper treatment of his or her health condition and for asking the patient questions about the information presented. Such interactive educational programs for teaching a patient about a health condition are well known in the art. Web server **106** also includes a patient database **42** for storing plan specification **44** received from workstation **24** and patient responses **120** to program **114**.

Web server **106** further includes a router **118** for routing patient access between educational program **114** and a web entertainment program **116**. Web server **106** additionally includes evaluation program **56**. In this embodiment, evaluation program **56** is designed to compare patient responses **120** received in database **42** to the evaluation criteria specified in plan specification **44** to determine a compliance status of the patient. Evaluation program **56** also includes program logic for performing various control functions described in the operation section below. Specific techniques for creating an evaluation program to perform the control functions described are well known in the art.

Set-top processor **15** includes a web browser program **110** stored in memory **74**. Set-top processor **15** also includes a modem **108**. Microprocessor **70** is connected to memory **74** and modem **108** to execute browser program **110** and access web server **106** through internet communication network **112**. Set-top processor **15** also includes control receiver **102** connected to microprocessor **70** for receiving infrared signals **100** from remote control **98**.

The operation of the fourth embodiment is shown in FIG. **17**. FIG. **17** is a flow chart showing a preferred method of using system **105** to control patient access to entertainment program **116**. In step **400**, plan specification **44** is stored in web server **106** through workstation **24**. Next, the patient accesses web server **106** through set-top processor **15** and network **112**. Router **118** initially routes the patient to educational program **114** and restricts access to entertainment program **116**. Educational program **114** is displayed on television **16**, step **402**.

As the patient interacts with educational program **114**, he or she enters patient responses **120** using remote control **98**. Patient responses **120** are received by web server **106** and

stored in database **42**, step **404**. Next, evaluation program **56** compares the patient responses to the criteria specified in plan specification **44**, step **406**. Evaluation program **56** then determines if the patient is in compliance, decision step **408**. If the patient is in compliance, access is granted to entertainment program **116**, step **410**. To grant access, evaluation program **56** instructs router **118** to route the patient to entertainment program **116**.

If the patient is not in compliance, access is restricted to entertainment program **116**, step **412**. Router **118** continues to restrict the patient's access to entertainment program **116** until evaluation program **56** determines that the patient is in compliance. The remaining operation of the fourth embodiment is analogous to the operation of the preferred embodiment described above.

SUMMARY, RAMIFICATIONS, AND SCOPE

Although the above description contains many specificities, these should not be construed as limitations on the scope of the invention but merely as illustrations of some of the presently preferred embodiments. Many other embodiments of the invention are possible. For example, the invention is not limited to controlling patient access to a television program or world wide web program. The method of the invention is equally effective for controlling access to any entertainment program which may be broadcast or otherwise transmitted to consumers. In embodiments that control access to television programs, the invention is not limited to cable television systems. It is anticipated that the method of the invention will be used with direct broadcast satellite systems or any other system for broadcasting television programming.

Additionally, the set-top processor described is exemplary of just one possible embodiment of the invention. Those skilled in the art will appreciate that many other types of processors may be used to restrict access to an entertainment program. For example, an alternative embodiment includes a processor having a signal decoder which is selectively enabled and disabled by an entertainment broadcast company. In this embodiment, the broadcast company receives the patient's compliance status directly from the central server or healthcare provider and grants or restricts access to its broadcast entertainment programs by selectively enabling and disabling the processor.

Further, the preferred embodiment describes the use of medical monitoring devices and telephones for collecting compliance data from the patient. However, many other methods of collecting data from a patient are possible in alternative embodiments. For example, the patient could be provided with an electronic logbook and modem for transmitting compliance data via telephone lines. In another embodiment, the patient is provided with a paper based logbook and an automated reader for digitizing and transmitting the compliance data to the patient database. Alternatively, the patient could mail or fax the compliance data to the healthcare provider for entry into the database.

The compliance questions and compliance instructions illustrated are exemplary of just one possible embodiment of the invention. Many other questions and instructions may be displayed or telephoned to patients in alternative embodiments. Additionally, the preferred embodiment describes a system and method for encouraging patients having diabetes. However, the invention is not limited to diabetic patients. The system and method described are equally effective for patients having asthma, hypertension, cardiovascular disease, eating disorders, HIV, mental health disorders, or any other health condition requiring a treatment plan.

Therefore, the scope of the invention should be determined not by the examples given but by the appended claims and their legal equivalents.

What is claimed is:

1. A system for controlling patient access to an entertainment program to encourage a patient to comply with a treatment plan, the system comprising:

a) a monitoring means for collecting patient compliance data;

b) a memory means for storing compliance evaluation criteria;

c) an evaluation means for comparing the compliance data to the evaluation criteria to determine if the patient is in compliance with the treatment plan; and

d) an access control means in communication with the evaluation means for granting access to the entertainment program if the patient is in compliance with the treatment plan and for restricting access to the entertainment program if the patient is not in compliance with the treatment plan.

2. The system of claim **1**, wherein the memory means further stores compliance instructions and the system further comprises a display means in communication with the memory means for displaying the instructions to the patient.

3. The system of claim **2**, wherein the instructions include a description of at least one action the patient must perform to satisfy the evaluation criteria.

4. The system of claim **1**, wherein the compliance data comprises measurements of a physiological condition of the patient and the monitoring means comprises a monitoring device for producing the measurements.

5. The system of claim **1**, wherein the compliance data comprises patient answers to compliance questions and the monitoring means comprises a telephone and an automated call processing means for asking the compliance questions and for receiving the patient answers through the telephone.

6. The system of claim **1**, wherein the compliance data comprises patient answers to compliance questions and the monitoring means comprises a display means for displaying the compliance questions to the patient and a user input device in communication with the display means for entering the patient answers.

7. The system of claim **1**, wherein the compliance data comprises patient responses to an interactive educational program and the monitoring means comprises a program display means for displaying the educational program to the patient and a user input device in communication with the program display means for entering the patient responses.

8. The system of claim **1**, further comprising a workstation in communication with the monitoring means and the evaluation means for displaying the compliance data and a compliance status of the patient to a healthcare provider.

9. The system of claim **1**, further comprising a workstation in communication with the memory means for entering the evaluation criteria into the memory means.

10. The system of claim **1**, wherein the entertainment program comprises a web program and the access control means comprises a web server for granting and restricting access to the web program.

11. The system of claim **1**, wherein the entertainment program comprises a television program and the access control means comprises a television set-top processor.

12. The system of claim **11**, wherein the set-top processor includes the evaluation means.

13. The system of claim **1**, wherein the evaluation means is located on a server in communication with the set-top processor.

14. A system for encouraging a patient to comply with a treatment plan, the system comprising:

a) a program display means for displaying an entertainment program to the patient;

b) a monitoring means for collecting patient compliance data;

c) a server in communication with the monitoring means for receiving the compliance data, the server including a database for storing compliance evaluation criteria and an evaluation means for comparing the compliance data to the evaluation criteria to determine a compliance status of the patient; and

d) an access control means in communication with the server and the program display means for controlling access to the entertainment program in dependence upon the compliance status of the patient.

15. The system of claim 14, wherein the database further stores compliance instructions and the system further comprises instruction display means for displaying the instructions to the patient.

16. The system of claim 15, wherein the instructions include a description of at least one action the patient must perform to satisfy the evaluation criteria.

17. The system of claim 14, wherein the compliance data comprises measurements of a physiological condition of the patient and the monitoring means comprises a monitoring device for producing the measurements.

18. The system of claim 14, wherein the compliance data comprises patient answers to compliance questions and the monitoring means comprises a telephone and an automated call processing means for asking the compliance questions and for receiving the patient answers through the telephone.

19. The system of claim 14, wherein the compliance data comprises patient answers to compliance questions and the monitoring means comprises a question display means for displaying the compliance questions to the patient and a user input device in communication with the question display means for entering the patient answers.

20. The system of claim 14, wherein the compliance data comprises patient responses to an interactive educational program and the monitoring means comprises an educational program display means for displaying the educational program to the patient and a user input device in communication with the educational program display means for entering the patient responses.

21. The system of claim 14, further comprising a workstation networked to the server for entering the evaluation criteria into the database.

22. The system of claim 14, further comprising a workstation networked to the server for displaying the compliance data and the compliance status to a healthcare provider.

23. The system of claim 14, wherein the program display means comprises a television and the entertainment program comprises a television program.

24. The system of claim 23, wherein the access control means comprises a television set-top processor connected to the television.

25. The system of claim 14, wherein the server comprises a web server and the entertainment program comprises a web program.

26. A method for controlling patient access to an entertainment program to encourage a patient to comply with a treatment plan, the method comprising the following steps:

a) collecting in an access control system compliance data for determining if the patient is in compliance with the treatment plan;

b) storing in the access control system compliance evaluation criteria;

c) determining in the access control system if the patient is in compliance with the treatment plan by comparing the compliance data to the evaluation criteria;

d) granting access to the entertainment program if the patient is in compliance with the treatment plan; and

e) restricting access to the entertainment program if the patient is not in compliance with the treatment plan.

27. The method of claim 26, further comprising the step of displaying to the patient compliance instructions.

28. The method of claim 27, wherein the instructions include a description of at least one action the patient must perform to satisfy the evaluation criteria.

29. The method of claim 26, wherein the compliance data comprises measurements of a physiological condition of the patient, the access control system includes a monitoring device for producing the measurements and a memory means in communication with the monitoring device for storing the measurements, and the step of collecting the compliance data in the access control system comprises the step of transmitting the measurements from the monitoring device to the memory means.

30. The method of claim 26, wherein the compliance data comprises patient answers to compliance questions and the step of collecting the compliance data comprises the steps of asking the compliance questions and receiving the patient answers through an automated telephone call.

31. The method of claim 26, wherein the compliance data comprises patient answers to compliance questions and the step of collecting the compliance data comprises the step of displaying the compliance questions to the patient on a display unit and entering the patient answers through a user input device.

32. The method of claim 26, wherein the compliance data comprises patient responses to an interactive educational program and the step of collecting the compliance data comprises the step of displaying the educational program to the patient on a display unit and entering the patient responses through a user input device.

33. The method of claim 26, further comprising the step of displaying the compliance data to a healthcare provider.

34. The method of claim 26, further comprising the step of displaying a compliance status of the patient to a healthcare provider.

35. The method of claim 26, wherein the access control system comprises a television set-top processor and the step of storing the evaluation criteria in the set-top processor comprises the step of transferring the evaluation criteria from a healthcare provider computer to the set-top processor using a data storage card.

36. The method of claim 26, wherein the entertainment program comprises a television program and access to the television program is granted and restricted using a television set-top processor.

37. The method of claim 26, wherein the entertainment program comprises a web program and access to the web program is granted and restricted by a web server.

38. A method for encouraging a patient to comply with a treatment plan, the method comprising the following steps:

a) providing a program display unit for displaying an entertainment program to the patient, an access control means connected to the program display unit for controlling access to the entertainment program, and a server in communication with the access control means, the server including a database;

b) collecting in the database compliance data for determining a compliance status of the patient;

c) storing in the database compliance evaluation criteria for evaluating the compliance data;

d) determining the compliance status of the patient by comparing the compliance data to the evaluation criteria; and

e) granting or restricting access to the entertainment program in dependence upon the compliance status of the patient by transmitting an access control signal from the server to the access control means.

39. The method of claim **38**, further comprising the step of displaying compliance instructions on the program display unit.

40. The method of claim **39**, wherein the instructions include a description of at least one action the patient must perform to satisfy the evaluation criteria.

41. The method of claim **38**, wherein the compliance data comprises measurements of a physiological condition of the patient and the step of collecting the compliance data in the database comprises the steps of producing the measurements with a monitoring device and transmitting the measurements from the monitoring device to the database.

42. The method of claim **38**, wherein the compliance data comprises patient answers to compliance questions and the step of collecting the compliance data comprises the steps of asking the compliance questions and receiving the patient answers through a telephone.

43. The method of claim **38**, wherein the compliance data comprises patient answers to compliance questions and the step of collecting the compliance data comprises the step of displaying the compliance questions on the program display unit and entering the patient answers through a user input device.

44. The method of claim **38**, further comprising the step of displaying the compliance data to a healthcare provider.

45. The method of claim **38**, further comprising the step of displaying a compliance status of the patient to a healthcare provider.

46. The method of claim **38**, wherein the entertainment program comprises a television program, the program display unit comprises a television, and the access control means comprises a television set-top processor.

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